With METALLURGICAL SUPPLEMENT.

The Engineer.

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VOL. CLI.—No. 3933] LONDON: FRIDAY EVENING, MAY 29, 1931 [PRICE {WITH SUPPLEMENT} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

Cambridgeshire Education
COMMITTEE.
CAMBRIDGE AND COUNTY SCHOOL OF ARTS, CRAFTS AND TECHNOLOGY.

WANTED, in September, 1931, an experienced GRADUATE ASSISTANT MASTER, with experience in Mechanical or Electrical Engineering, to Teach Engineering Science and cognate subjects in the Day Trade School, and Engineering Subjects up to the third year standard in the Evening School.

Salary will be paid in accordance with the Burnham Scale.

Application forms (to be returned as soon as possible) may be obtained on the receipt of a stamped and addressed foolscap envelope from the EDUCATION SECRETARY, County Hall, Cambridge.

18th May, 1931. 7021

PATENTS AND DESIGNS ACTS, 1907 TO 1928.

Notice is Hereby Given that

THE RAYBESTOS COMPANY, of 1427, Railroad-avenue, Bridgeport, Connecticut, U.S.A., SEEK LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 128,706, granted to Sumner Simpson for an invention entitled "Improvements in Clutch and Brake Friction Facings and in the Process of Making the same."

Particulars of the proposed Amendment were set forth in No. 2209 of the Illustrated Official Journal (Patents), published on the 20th May, 1931.

Any person or persons may give Notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of publication of the said Journal.

(Signed) W. S. JARRATT,
Comptroller-General.

7017

County of London.

The London County Council invites TENDERS for the MANUFACTURE, SUPPLY, and INSTALLATION at the Greenwich Power Station of THREE 3-PHASE STATIC TRANSFORMERS with E.H.T. and L.T. SWITCHGEAR.

The specification, drawings, form of Tender and general conditions may be obtained from the General Manager of Tramways, Tramways Offices, 23, Belvedere-road, S.E. 1, upon payment of £1. This amount will be repayable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application and the contract documents may be inspected before payment of the fee.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in "The London County Council Gazette."

No Tender received by the Clerk of the Council, The County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 22nd June, 1931, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX,
7022 Clerk of the London County Council.

Eastleigh and Bishopstoke
SEWERAGE, CONTRACT No. 3.

TENDERS are INVITED for the CONSTRUCTION of SEWAGE DISPOSAL WORKS on the existing Sewage Farm site adjoining the Southern Railway Works at Eastleigh.

Particulars will be given and copies of the specification, general conditions, bills of quantities and form of Tender may be obtained from the Engineers, Messrs. A. P. I. Cotterell and Son, 54, Victoria-street, Westminster, S.W. 1, during the hours of 9.30 a.m. to 11.30 a.m. and 3 p.m. to 5 p.m., or at the office of the Surveyor to the Eastleigh and Bishopstoke Urban District Council, by intending contractors, on or after the 12th June, 1931, on payment of the sum of Five Guineas, which will be returned on receipt of a bona fide Tender, and all other documents supplied.

Tenders, on the forms provided, enclosed in sealed envelopes, must be delivered, accompanied by the priced bills of quantities, to the undersigned and endorsed "SEWAGE DISPOSAL WORKS CONTRACT No. 3," not later than 10 a.m. on the 12th July, 1931. Copies of the specification and general conditions are to be returned to the Engineers at the same time.

Contractors will be required to provide securities for performance of the contract under Sec. 174 (4) of the Public Health Acts.

The Council do not undertake to accept the lowest or any Tender.

J. LAWRENCE,
Clerk to the Eastleigh and Bishopstoke Urban District Council.

Town Hall,
Eastleigh, Hants. 7026

Metropolitan Water Board.

TENDERS FOR THE MANUFACTURE, DELIVERY AND ERECTION OF ONE VERTICAL HIGH-COMPRESSION HEAVY FUEL OIL ENGINE AND CENTRIFUGAL PUMPS, &c., AT HONOR OAK PUMPING STATION.

The Metropolitan Water Board invite TENDERS for the MANUFACTURE, DELIVERY and ERECTION of ONE VERTICAL HIGH-COMPRESSION HEAVY FUEL OIL ENGINE and CENTRIFUGAL PUMPS, &c., at their Honor Oak Pumping Station, Hall-road, London, S.E. 10.

Forms of Tender, conditions of contract, specification and drawings may be inspected without payment of a fee at the offices of the Board, Chief Engineer's Department (Room 173), on and after Monday, 1st June, 1931.

Contractors desirous of tendering may obtain the necessary documents from the Chief Engineer on production of an official receipt for the sum of Two Guineas, which must be deposited with the Accountant to the Board and which will be returned on receipt of a bona fide Tender accompanied by all the above-named documents and drawings. Such payments and applications must be made between the hours of 10 a.m. and 4 p.m. (Saturdays, 10 a.m. and 12 noon). Cheques must be made payable to the Metropolitan Water Board and not to individuals.

Tenders, enclosed in sealed envelopes addressed to the Clerk of the Board and endorsed "Tender for Engine and Pumps, Honor Oak," must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Friday, 26th June, 1931.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1.
22nd May, 1931. 7024

The Engineer

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PUBLIC NOTICES

The Manchester Steam Users' ASSOCIATION.

For the Prevention of Steam Boiler Explosions and for the Attainment of Economy in the Application of Steam. 20, QUAY-STREET, DEANSGATE, MANCHESTER.

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The County Councils of CARDIGANSHIRE AND PEMBROKESHIRE.

CONSTRUCTION OF NEW BRIDGE AND APPROACHES AND DEMOLITION OF EXISTING BRIDGE AT LLECHRYD, OVER THE RIVER TEIFY.

The Councils are prepared to receive TENDERS from contractors experienced in similar work for the DEMOLITION and RECONSTRUCTION in REINFORCED CONCRETE of LLECHRYD BRIDGE and CONSTRUCTION of APPROACHES in the Counties of Cardiganshire and Pembrokeshire.

The existing bridge is to be demolished and replaced by a reinforced concrete bridge with approaches.

Drawings and specification, &c., may be seen on and after Tuesday, 2nd June, 1931, at the offices of :—

John Davies, M. Inst. M. and Cy. E., County Surveyor, County Offices, Horeb, Llandyssul, Cardiganshire ;

Arthur H. Thomas, A.R.I.B.A., County Surveyor, Willesden House, Haverfordwest, Pembrokeshire ;

Sir E. Owen Williams, K.B.E., 5, St. George's-road, Westminster, London, S.W. 1.

Documents, including bill of quantities and drawings, may be obtained on and after the same date at the office of Sir E. Owen Williams, K.B.E., 5, St. George's-road, Westminster, S.W. 1, on depositing £2 2s. and the receipt of an undertaking to return all such documents and drawings. Cheques must be made payable to the County Councils of Cardiganshire and Pembrokeshire. The deposit will be returned on receipt of a bona fide Tender.

Sealed Tenders, endorsed "Tender, Llechryd Bridge," must be lodged with the contract documents complete with the undersigned not later than 10 a.m. on Tuesday, 23rd June, 1931.

The County Councils do not bind themselves to accept the lowest or any Tender.

ROBERT A. WHEATLEY,
Clerk to the County Council of Pembrokeshire.
County Offices, Haverfordwest,
20th May, 1931. 7018

PUBLIC NOTICES

Bombay, Baroda and Central INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to Noon on Friday, 12th June, TENDERS for the SUPPLY of :—
DOG SPIKES.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices : The White Mansion,
91, Petty France, Westminster, S.W. 1,
22nd May, 1931. 7028

Administrative County of LONDON.

The London County Council invites APPLICATIONS for the POSITION of SUPERINTENDENT of the Abbey Mills and Isle of Dogs Sewage Pumping Stations.

The person appointed will be responsible to the Chief Engineer of the Council for the official management of the stations. The machinery, which is worked continuously, comprises electrical, steam and gas-driven centrifugal pumping sets and auxiliary plant, with an aggregate of about 9000 H.P., including electrical high-tension plant. The staff numbers about 100.

Candidates must be not under 35 or over 50 years of age on the latest date for receiving applications, and must have had considerable practical experience in the operation and maintenance of similar prime movers (particularly modern high-tension electrical plant, and preferably of pumping plant), the supervision and control of staff with shift working, and the general maintenance of premises, buildings, &c.

The salary attached to the position is £515 a year, rising to £640 by yearly increments of £25. A house (with coal and light) is provided at the pumping station, free of charge.

Applications must be made on the official form, copies of which, with full particulars, may be obtained by sending a stamped addressed envelope (marked "Superintendent, Abbey Mills, &c.") to the Clerk of the Council, The County Hall, Westminster Bridge, S.E. 1. Forms must be received by Monday, 15th June, 1931.

Canvassing disqualifies.

MONTAGU H. COX,
7023 Clerk of the London County Council.

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, ASSISTANT MANAGER. Must be Thoroughly experienced Designer of Conveying and Elevating Plants and Structural Work. state age, full details of experience and salary expected.—Address, P1111, The Engineer Office. P1111 A

WANTED, ASSISTANT SHIPYARD MANAGER for Clyde yard, preferably acquainted with Warship production ; only those with several years' practical experience and drawing-office training need apply.—Write, stating age, experience, and salary required, to "C. B.," c/o Street's, 6, Gracechurch street, London, E.C. 3. 7030 A

WANTED, ENGINEER as Assistant in Marine Engineering Establishment on the Clyde, preferably acquainted with Warship Machinery ; only those technically trained and with several years' practical experience need apply.—Write, stating age, experience, and salary required, to "C. K.," c/o Street's, 6, Gracechurch-street, London, E.C. 3. 7029 A

WANTED IMMEDIATELY, Real Live MAN to Take Charge of Dept. selling Steel Joists and other Sections from Depot Stock. Connection in London and Home Counties essential. Knowledge of Light Structural Work an advantage. Full particulars and salary required.—Address, 7032, The Engineer Office. 7032 A

A LARGE FIRM of ENGINEERS, Midlands, has VACANCY for PREMIUM PUPIL. Excellent opportunity for youth of character, energy, and engineering aptitude.—Address, 7019, The Engineer Office. 7019 A

CIVIL ENGINEERING DESIGNER REQUIRED for London ; must be thoroughly competent to Execute Calculations on Flow of Water and Reinforced Concrete Work. Knowledge of Sewage Practice and Municipal Work desirable. State full details of training and experience in above and other branches, age, and salary required.—Address, 7030, The Engineer Office. 7030 A

ENGINEER-FITTER for STEAM LORRIES REQUIRED by Road Contractors ; must be practical with general experience of Running Repairs. Preferably conversant Furnace Work and Small Pumps.—Write, giving full details age, experience, with undeniable references, salary expected, Box 4442, "Homefinders," 74, Victoria-street, London, S.W. 1. P1132 A

£1000.—MANUFACTURER'S SON REQUIRED as REPRESENTATIVE for London in specialised line. Highest references required and given.—Address, P1095, The Engineer Office. P1095 A

WANTED, a CHIEF DRAUGHTSMAN and ENGINEER for General Engineering Works in North of England ; must be of highest character, well versed theoretically and practically, and used to Cotton Mill Work.

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Address, stating age, training, experience and salary, 7034, The Engineer Office. 7034 A

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SITUATIONS WANTED

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ENGINEER (36), Extensive Experience of Modern production methods for the manufacture of small accurate mechanisms, electrical and mechanical, used to control of all classes of labour, several years in managerial positions, DESIRES POST as Works Manager or Production Manager.—Address, P1120, The Engineer Office. P1129 B

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MECHANICAL ENGINEER (44), 12 Years Works manager in general engineering works, DESIRES POSITION of RESPONSIBILITY as Manager or Assistant or Plant Engineer.—Address, P1119, The Engineer Office. P1119 B

YOUNG MAN SEEKS POSITION with Structural Engineers as Draughtsman's Calculator. Exam. equivalent matriculation. Knowledge higher maths., stress, bending moment and shear force diagrams.—Address, P1123, The Engineer Office. P1123 B

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are instructed to offer for SALE BY AUCTION (unless previously sold by Private Treaty) on TUESDAY, JULY 14th, 1931, at eleven o'clock precisely, and on the following days, on the Premises at STOWMARKET.

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Particulars, plan, conditions of sale, and catalogues of plant and machinery, when ready, may be had of Messrs. Peat, Marwick, Mitchell and Co., Chartered Accountants, 11, Ironmonger Lane, London, E.C. 2, and 2, Park Place, Leeds; Messrs. Wilde, Wigston & Saptes, Solicitors, 21, College Hill, London, E.C. 4; and of the Auctioneers, Messrs. Hillier, Parker, May and Rowden, at their offices below.

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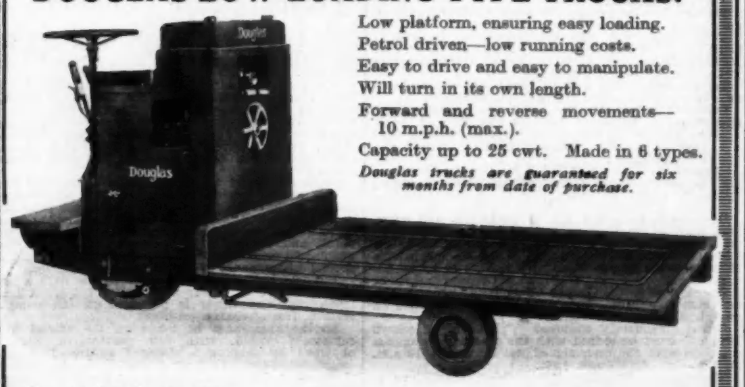

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BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY,
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P1043 I

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Unemployment in America.

IT has been known for some time that unemployment in America is high, and numerous estimates, with a varying degree of reliability, of the number of persons without work have been made. The question is touched upon in a report recently issued by the Department of Overseas Trade, entitled "Economic Conditions in the United States of America." The Metropolitan Life Insurance Company secured information from its policy holders in forty-six cities in the belief that they represented a good sample of the country's working population, although agricultural labour would not be included The result showed that 23·8 per cent. of the workers questioned were totally unemployed and 21·3 per cent. were working part time. If the sample was a good one and if the percentages were applied to the whole population, excluding three million agricultural workers and thirteen million self-employed, the conclusion would be arrived at that seven million persons were unemployed in the early part of December last year. The American Federation of Labour, however, did not reach such a high estimate, giving the figures as 3,700,000 for the first six months of last year and as 4,860,000 for the second six months. The official Census returns of April 30th, 1930, showed that on that date 2,508,501 persons were looking for employment, but this figure did not include those nominally employed but actually temporarily laid off without pay. The head of the President's emergency relief committee is quoted as an authority for an estimate of 4½ to 5 millions of totally unemployed at the end of the year, while the observation of the writers, Sir J. Joyce Broderick and Mr. Arthur J. Pack, would suggest that the number exceeds 5 millions, or 10 per cent. of the working population.

Franco-British Trade.

THE visit of Mr. Gillett, Under-Secretary of State for Overseas Trade, to the Paris Fair and the banquet offered to him under the presidency of the French Minister of Commerce, constitute an event which may influence the French attitude towards a more liberal conception of what should be done to encourage trade between the two countries. So long as France remained little affected by the world crisis she could not relinquish the idea that the development of her home and colonial resources would suffice to ensure a national prosperity. Now that French trade and industry, like those of other countries, are suffering from general economic causes, it is seen that international solidarity is something more than a phrase. Constructive work must be carried out on a basis which will give stability to trade, and the French therefore accorded a specially warm welcome to the British representative when, at the banquet, the French Minister of Commerce emphasised the importance of an equitable commercial arrangement between the two countries, though he was careful to explain that, in view of the larger total of British imports into France as compared with the French exports to Great Britain, this country would be expected to make concessions. The British exports to France are mostly coal and raw material, which necessitate a minimum of British labour and are indispensable to French commerce and industry. The French imports into this country are mostly finished products. It may be difficult to induce the French to provide facilities for the importation of British engineering goods for the reason that the same advantage would have to be accorded to other countries enjoying most favoured treatment.

Mechanical Warfare.

AT the invitation of the War Office, members of the councils of several engineering societies had the pleasure of witnessing a striking demonstration of the capabilities of Army mechanical vehicles at Aldershot on Thursday afternoon, May 21st. A grandstand had been erected on a convenient elevation overlooking both rough and level ground, with, in the near foreground, a deep pit, a section of a trench, and a bank with gradient of about 1 in 4. Much of the terrain is loose and sandy. In this appropriate theatre the various types of mechanical vehicles which have been developed by the Mechanical Warfare Board and by private firms, were put through their paces. The numerous engineers who witnessed the demonstration were impressed as much, if not more, by the remarkable powers of endurance of the materials of the vehicles as by the things they did and the ease, under apparently great discomfort, with which they were handled. The variety of types was remarkable. It ranged from the familiar slow-speed tanks of the war through their modern counterparts, which can achieve a speed of 30 miles an hour, down to a little six-wheeled "galloper," with a four-wheel drive which amused the spectators by its antics over the sand hills. Some of the eight-wheeled vehicles were provided with all the axles driving and all articulated so that however broken the contour might be, all wheels remained in contact with the ground. These machines were fitted with balloon tires up to 12in. and even 13½in. in diameter, but many of the others were fitted with tracks of various kinds, and the spectators were astonished by the facility with which they could be manœuvred. A few of them climbed the sandy elevation right in front of the grandstand until they came within touching distance of the spectators, and then turning upon their own centres scuttled—the word is accurate—down the hill throwing up a cloud of sand behind them. No one who witnessed the demonstration could fail to be impressed by the really astounding progress that has been made in a few years both in design and in the production of materials which can stand for many miles—in some cases as much as a thousand—the severe punishment these machines are called upon to endure.

The British Broadcasting Corporation.

THE fourth annual report of the British Broadcasting Corporation shows that during 1930 the total number of transmitter hours was 72,396, and that the percentage breakdown time was 0·04, representing 82 minutes' breakdown per transmitter. Work on the new B.B.C. headquarters proceeded throughout the year and, in general, progress was satisfactory. The building reached its full height and a good deal of the internal work was completed. The design gave rise to the consideration of various complicated problems owing to the special requirements of the studios. On March 9th, 1930, the full service of alternative programmes was begun at the London Regional Station which has proved highly satisfactory. Constructional work on the North Regional Station continued, and at the end of December preliminary tests began. Owing to the exposed nature of the site, this station took three months longer to build than the London station. Tests on possible sites for the Scottish Regional Station were concluded, and a site at Westerglen, near Falkirk, was selected. Tests were also carried out with a view to finding a suitable site for the West Regional Station on the coast of Somersetshire, but owing to complications with Air Ministry activities in the district it was not possible to make a final selection. A building at Edinburgh, containing one of the largest studios in the world, was made the Corporation's Scottish headquarters. During the year considerable use was made of the commercial wireless telephone circuit to America *vid* Rugby. Programmes were also radiated from Australia and from a ship at sea *vid* commercial wireless telephone circuits.

Miners' Wages.

THE results of an inquiry into the wages and hours of work of miners engaged in the European mining industry during 1929 have recently been published by the International Labour Office. In consequence of the lengthening of the hours of work in 1926 and certain reductions in wages in Great Britain, combined with increases in wage rates in some continental countries, the great difference between British wages and those of most other countries has been very much reduced. Reckoning in labour costs per ton, excluding insurance contributions paid by the employer and taking the figure for Britain as 100, then that for Belgium in 1929 was 120, for France 104, for the Ruhr 84, and for Poland 43, whereas in 1925 the figures were respectively 100, 99, 81, 63, and 38. The contributions towards insurance paid by the employers amounted in Britain to 5·3 per cent. of the total wages; in Poland, Czecho-Slovakia and the Netherlands to more than 9 per cent., and in Germany to as much as 12 per cent. In the figures of output per man shift for Britain there is reflected very strikingly the effect of the increase in hours since 1925, when seven hours a day were worked. In that year the figure was 1·159, while in 1929 it was 1·395. The man output per year increased from 284 metric tons to 348. In the Ruhr the corresponding figures for 1925 and 1929 were 1·179 and 1·557 and 313 and 422 metric tons. It is interesting to note that in 1929 the longest working day of any of Europe was to be found in some British coalfields. As the drafting of a convention for regulating the hours of work underground is to be begun by the International Labour Conference at Geneva shortly, the figures are likely to be of some importance.

A New Aeroplane Launching Gear.

ON Thursday of last week, May 21st, there was demonstrated at the Royal Aircraft Establishment at Farnborough a new type of catapult gear, which has been designed for the launching of large military aeroplanes from confined spaces. With a cross wind of over 15 miles per hour, a Virginia twin-engined bomber weighing over 7 tons took off and was in the air in three seconds after a run of only 100ft., compared with a more usual take-off run of up to nine times that length. The new apparatus, unlike that which has been employed on ships, launches its aeroplane by traction instead of propulsion. A launching cable, which is wound on a drum driven by a compressed air engine, is run forward over the aerodrome and after passing round a fixed pulley is returned and connected by quick-release hooks to the underpart of the machine fuselage. When the drum is rotated the aeroplane is pulled forward on its own undercarriage. There is an additional trolley attachment in order to maintain the tail of the machine in the flying position. The compressed air engine is supplied from six air cylinders through a reduction valve and an expansion chamber, and the revolutions increase from zero to 2000 r.p.m. in the first two seconds of the three seconds necessary for launching. When the end of the run is reached, the retarding mechanism of the catapult releases both the cable hooks and trolley, and the aeroplane takes off under its own power. The apparatus is designed to give a 10-ton machine a speed of about 60 miles per hour, the acceleration being greater than with a ship's catapult. On Thursday last the Virginia bomber took off at a speed of 57 miles per hour before the end of the run was reached. At present the catapult mechanism is anchored to a concrete base, but plans for putting the apparatus on a transportable wheeled base have also been made.

Professor Desch and the N.P.L.

PROFESSOR C. H. DESCH has been appointed Superintendent of the Metallurgy Department of the National Physical Laboratory, in succession to Dr. Rosenhain. Professor Desch is a Fellow of the Royal Society, and of the Institute of Chemistry, and holds the degrees of D.Sc. (Lond.) and Ph.D. (Würzburg). He is at present Professor of Metallurgy, and Dean of the Faculty, in the University of Sheffield, and was formerly Professor of Metallurgy in the Royal Technical College, Glasgow, and Graham Young Lecturer in Metallurgical Chemistry in the University. He is a Past-president of the Faraday Society and of Section B (Chemistry) of the British Association, and a Vice-president of the Iron and Steel Institute, and is recognised as one of the foremost authorities on metallurgical questions. Professor Desch will not take up his new appointment until February, 1932, as he had previously accepted an invitation from Cornell University to give a course of lectures there during the winter session of 1931–32.

A Merger of Manufacturers of Textile Machinery.

A SCHEME for the amalgamation of a number of textile machinery firms, which has been prepared by Sir Gilbert Garnsey, was referred to by Sir George Bullough, chairman of Howard and Bullough, Ltd., at the annual meeting recently. It will be submitted in a short time to the shareholders of the various firms concerned, which are Asa Lees and Co., Ltd., Brooks and Doxey, Ltd., Dobson and Barlow, Ltd., Howard and Bullough, Ltd., John Hetherington and Sons, Ltd., and Platt Bros. and Co., Ltd. The depression which has affected the cotton industry for several years, both at home and abroad, has reacted severely on the makers of textile machinery. In consequence, there has been fierce competition leading to price cutting. Repair work and overhauling work has decreased as the resources of the industry have become depleted, while the fact that a number of mills in Lancashire have been closed down and the machinery from them exported to markets abroad has had some effect on the demand in those markets. The plans of the Joint Committee of Cotton Trade Organisations, if carried out, will still further reduce the demand by eliminating redundant plant. The belief is expressed that shareholders of the firms concerned will look favourably upon any scheme that gives promise of improving trading conditions, but the terms proposed for the merger have not yet been published.

Copper Production in the British Empire.

THE presidential address of Mr. W. Pellew-Harvey at the annual meeting of the Institution of Mining and Metallurgy, which was held at Burlington House on Thursday of last week, May 21st, dealt with the relative effect of the fall in metal prices on base-metal mining compared with that of gold. Speaking on the production of copper in the British Empire, Mr. Harvey said that he looked forward to a great increase in the amount of copper produced within the Empire. Of the great potential producers, the Northern Rhodesian Copper Field appeared to be by far the most important. From reports made by reliable authorities it appeared that the discovery of this field might be taken to rank as second only to that of the Transvaal gold fields. It was estimated, Mr. Harvey went on to say, that by 1934 the group operating the mines would be in a position to produce annually about 300,000 tons of fire-refined copper. Preparations towards that end were well advanced and important interests were co-operating. It was hoped to keep the industry within the Empire and to establish an independent policy with regard to the Empire's copper position as a whole. The various interests in the field had, he understood, agreed eventually to refine their copper in this country. Such a course would, it was thought, enable the British groups to compete with the United States in securing a large participation in the continental markets, as well as those of the Empire. At the present moment, no electrolytic refining plant capable of dealing with any important tonnages of copper was at work, as far as he knew, in the United Kingdom. That an up-to-date large-capacity plant would be required was beyond question, and it was understood that some point in the United Kingdom would be chosen for its establishment.

THE HUDSON RIVER BRIDGE, NEW YORK

FIG. 1—FLOOR STEEL ERECTION COMPLETED, JANUARY 21ST, 1931

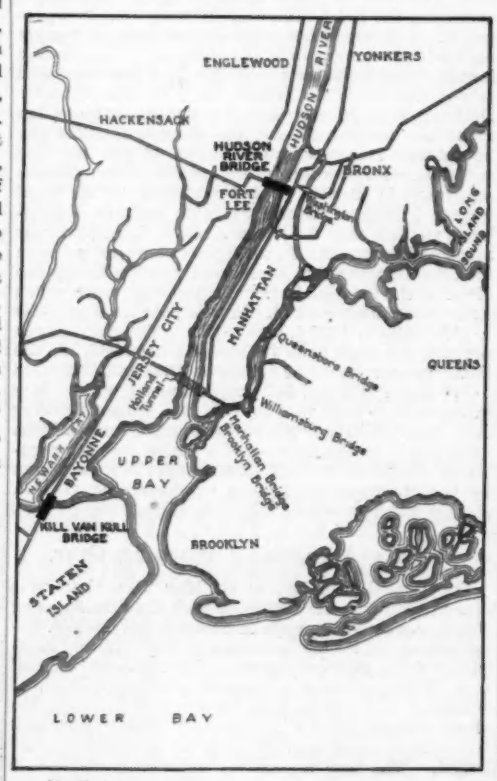
The Hudson River Bridge.

We have been favoured with a copy of the Fourth Progress Report on the Hudson River Bridge at New York between Fort Washington and Fort Lee, and we give in what follows a summary of its principal contents. Our readers will remember that we dealt, in a similar manner, with the first three Reports in our issues of April 20th, 1928, May 3rd, 1929, and August 1st, 1930, respectively. The present report, as were those that had preceded it, is signed by Mr. O. H. Ammann, Chief Engineer of Bridges to the Port of New York Authority, and there is, as in the others, a short introduction by Mr. J. E. Ramsey, the Chief Executive Officer to the Authority. In the Third Report Mr. Ramsey was able to announce that, so satisfactory had been the progress made with the work of construction, there was every likelihood that the bridge would be opened for traffic early in 1932. He is now able to report that "considering the speed with which construction is at present being carried on and the relatively small amount which remains to be done, it is confidently expected that the structure will be open to traffic in the latter part of 1931." As with the first three Reports, we again, in the present instance, quote, in large measure, verbatim from the document.

Mr. Ammann begins his report by recalling the facts that, at the time the Third Report was prepared, the rock cut for the approach and cable anchorage in New Jersey had been completed; the construction of the New York anchorage had been finished in its initial stage; the steel towers had been completed; the footbridges erected; and that the cable spinning operations were well advanced, 26,000 tons, or approximately 92 per cent. of the total cable required, having been manufactured and over 10,000 tons erected. He then goes on to say that, at the time of writing the present report—that is to say, on March 2nd, last—the cables and the floor system for the main structure had been completed, the cable-spinning operations having been sufficiently advanced to permit of the entire floor system being erected before the advent of severe winter weather. The progress during the period covered by the Report had, in fact, been extraordinarily rapid.

Cable Construction.

It will be recalled that the construction of the cables was undertaken during the year 1929 by the John A. Roebling's Sons Company. The erection of the necessary working scaffolds or footbridges and the methods and equipment used in spinning the cable wire were described in the Third Report and were reviewed in our illustrated summary. We may repeat here, however, that there are four suspending cables, arranged in



"The Engineer"

FIG. 2—MAP SHOWING POSITION OF BRIDGE

two pairs, 106ft. apart, one pair on each side of the bridge, the cables of each pair being arranged with their centres 9ft. apart. Each cable is 36in. in diameter and contains 26,474 parallel steel wires, each 0·196in. in diameter. These wires are divided into sixty-one groups or strands of 434 wires each, and each strand is attached to a separate pair of eye-bars at each anchorage. By the method used to spin the cables, the wires in any one strand are lengths of a continuous wire and are looped around castings at the anchorages. For any one cable, four strands were spun at a time in temporary supports adjacent to the cables. Upon completion of each set of four strands, the spinning was interrupted until the four completed strands could be seized, or bound at intervals, and placed in final position in the cable. To carry out the spinning and adjusting operations expeditiously, three spinning gangs were shifted in cycles from cable to cable, while one strand-adjusting gang worked in rotation on all four cables. The wire required to build the four cables amounted in weight to 28,307 tons. The first wire was put in place on October 18th, 1929, and the last on August 8th, 1930, and preparations were made for compacting the cables and assembling the suspender cutting and socketing equipment, so that the work of carrying out those operations might proceed immediately the spinning had been completed.

The cables were compacted and squeezed in two stages. It will be understood that, as roughly bound together, the strands assumed an hexagonal cross section. By the preliminary squeezing, which was effected by two light compactors, the hexagonal cross section was reduced to an approximately circular section. Each light compactor consisted of an hexagonal frame, with six radially-mounted hydraulic jacks, each being capable of exerting a pressure of 20 tons. The pressure was applied to the cable through steel shoes, the inside faces of which were shaped to fit, partially, the three strands at each corner of the hexagonal cable. On each side of the frame was mounted an additional hydraulic jack for tightening around the cable a steel seizing band at each application of the squeezer. Each compactor was mounted on a structural steel carriage, with wooden wheels which rode directly on the cable. The carriage held the hand pumps for operating the hydraulic jacks. It was moved along the cable by means of a hoisting engine, fixed at the anchorage. The squeezing was, in every case, started from the towers and progressed at 100ft. intervals to the anchorages, or the centre of the main span, as the case might be, and returned at 5ft. intervals. This preliminary squeezing, it is explained, was done, as far as possible, at night when the temperature of the cable wire at the top and bottom of the cable was more uniform than it was in the daytime, and the strands correspondingly more uniform in length. The operation was begun on July 31st and completed on August 14th of last year.

The final squeezing followed after the preliminary squeezing of the pair of cables in each span had been

completed. The machines used for this final compacting were eight in number, and were, generally, similar to the preliminary squeezers. They were, however, much heavier, and comprised twelve hydraulic jacks, each with a capacity of 50 tons, which were mounted radially, and which pressed against shoes, the inside faces of which were machined so as, together, to form a circle 36in. in diameter. For the main span, each of four large structural carriages, with wooden wheels designed to ride on a pair of cables, carried two compactor frames mounted at one end. An electrically-driven hydraulic pump was mounted on each carriage. The carriages were propelled by the tramway or hauling ropes, which had been used during the spinning operations.

The final compacting was started at the centre of the main span, and at the anchorages in the side spans, and progressed towards the towers, the operation of compacting being performed at intervals varying from 2ft. to 4ft. as was found necessary to obtain, as nearly as possible, a uniform diameter of 36in. The final squeezing was begun on August 12th and completed on September 20th.

The Suspenders.

Following the compacting, cast steel bands, over which were to be hung the cables for supporting the decking, were placed on the main cables. These bands were made in halves, and, when in position, the two halves completely encircled the cables and were held fixed in position by the friction developed between the castings and the cables when the halves were drawn up tightly by means of heat-treated, high tensile steel bolts. In the main span the castings were skidded into position along the footbridge decking and were erected by means of chain hoists and timber frames. In the side spans, the bands were transported from the anchorages to their final positions by carriages which operated on the cables.

When the cable bands were in position, the load of the footbridges—which were described in our summary of August 1st, 1930—was then transferred from the temporary cables, formed by two groups of nine 2¼in. wire ropes, to the main cables, after which these footbridge ropes were freed and lengthened, one at a time, by the insertion of a short connection—called a pennant line—at each tower. While supported and hanging freely suspended, the calculated suspender lengths were then measured under a condition of known stresses. This measuring was also done at night so as to secure the advantage of uniform temperature. After measuring, the ropes were lowered until they rested on the footbridges. The main span ropes were cut near the centre of the span, and the parts were wound on reels at the towers. The side span ropes were then released from their attachments at the anchorages and also reeled at the towers.

For carrying the decking, two suspender ropes were looped over each band, four socket ends being thus provided for attaching to the floor or decking. The process of converting the footbridge ropes into suspenders involved the cutting and socketing of, approximately, 35 miles of wire rope into 592 suspenders of various lengths. Cutting and socketing plants were erected at the top of each tower, and a system of handling, which exposed both ends of each suspender for the cutting and socketing operations, while retaining the looped portion, or "bight," on the reel, was developed.

To transport and place it in its final position on the cable, each suspender was unreeled at the top of the tower, ends first, one at each side of the cable, with the loop, or "bight," coming off the reel last. The suspender was then slid along the footbridge and the cable to its destined band, where the socketed ends were passed over large wood-lined sheaves and lowered into vertical position. In general, the suspender ropes were erected first at the bands adjacent to the towers in order that the work of erecting the steel floor might be undertaken at the earliest possible moment.

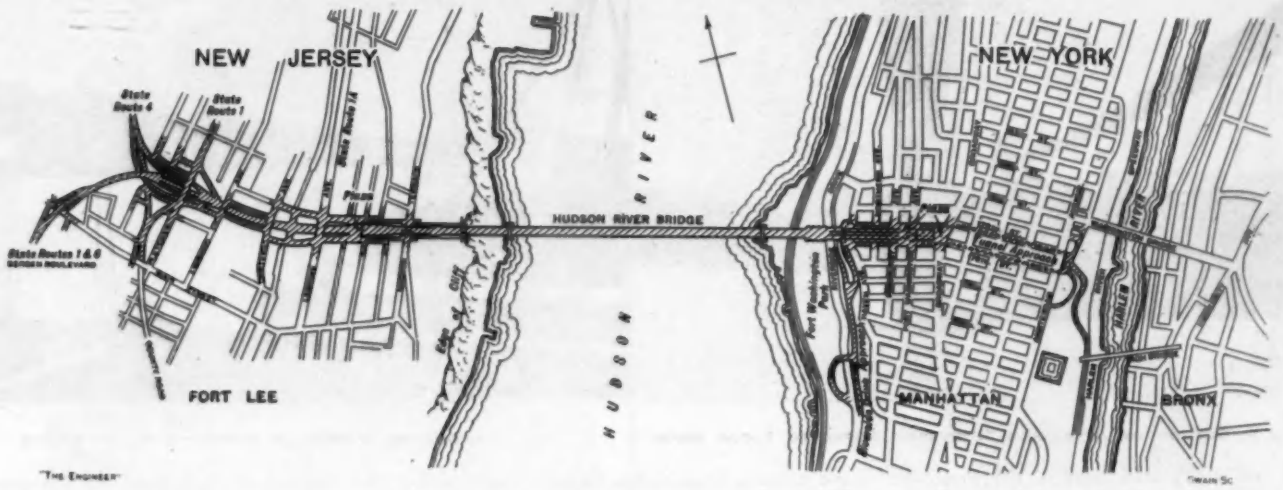


FIG. 3—PLAN OF BRIDGE AND APPROACHES

FIG. 4—VIEW THROUGH LOWER PORTAL OF NEW YORK TOWER

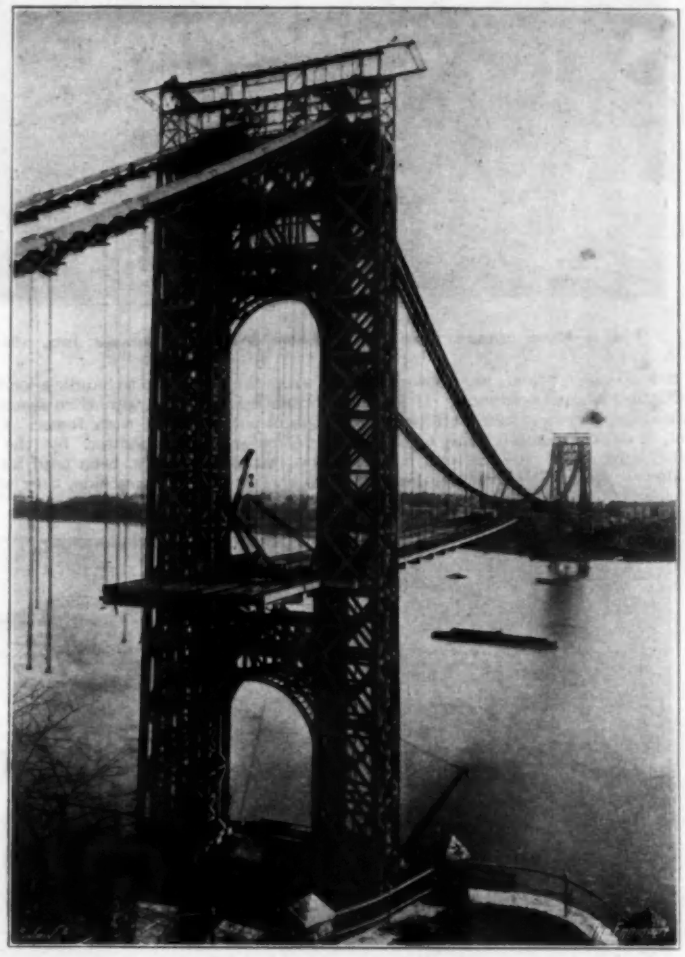


FIG. 5—FLOOR STEEL ERECTION, DECEMBER 10TH, 1930

The only thing necessary finally to complete the contract work on the cables is to wrap them. That process will be carried out during the present year, when the concrete of the roadway is in position. The addition of weight to the structure causes elastic stretch in the cables, and it was considered desirable that the greater part of the elongation should take place before the wrapping was applied.

THE FLOORING.

The provision and fixing of the steel floor of the bridge form a part of the contract for the erection of the towers, which was entered into with the McClintic Marshall Company. The bridge is intended, eventually, to carry traffic on two levels, the upper level, or deck, accommodating eight lines of vehicular traffic, and two footways, one on each side, while the lower deck will carry four lines of railway. At first, however, only the upper deck is being put into position, though all the necessary connections have been provided for the future addition of the lower deck and stiffening trusses. For the floor, main transverse beams are arranged at panel points at 60ft. intervals, and they are joined by eight longitudinal roadway stringers in each panel. On these stringers are secondary transverse beams at 5ft. intervals, which support bulb beams forming the reinforcement of the concrete slabs of the roadway. A fascia stringer and a longitudinal beam, adjacent to the roadway curb, support the beams carrying the footways. The steel work is stiffened against lateral wind movement by cross laterals connected to wind chords. The latter will form the top chords of the stiffening trusses when the lower deck is added.

The erection of the floor steel at the towers was begun on September 12th, 1930. A boom was assembled on the lower portal of each tower, and by means of it, the floor steel lying within the tower was erected. Two standard "A" frame travellers, each designed to handle a load of about 40 tons at a distance of 60ft., were then assembled side by side on the steel work at each tower. On the New York side, they were operated by the electric hoists which had, originally, been used for tower erection, while on the New Jersey side, they were operated by petrol-driven hoists. The erection of the steel work in the main span was effected by means of these travellers, the work proceeding from the towers towards the centre of the river. The steel was hoisted directly from lighters anchored in the river, which were moved on the completion of each panel. In every case, the first piece to be erected was the main floor beam, which weighed about 65 tons, and which was lifted by the two travellers and attached to the suspender ropes. The remaining members were then lifted by the travellers working independently. The first suspended steel work was got into position on October 28th, 1930, and the last panel was erected at the centre of the main span on December 29th, 1930.

After the main span travellers had advanced a few panels from the towers, the side-span travellers were assembled. One of the stiff-leg derricks, which had been previously used for the building of the towers, was used for each. Electric hoists arranged on the ground were employed for operating them. As the side spans are over land, the members were lifted from lighters to the floor level near the towers by means of additional derricks placed on towers, and were then carried over the floor steel to a position within reach of the erection traveller, which lifted each member in turn, swung it forward and set it in position. The side span erection operations were slower than those of the main span, two or three days being required to erect each side span panel, as compared with a day required to erect a main span panel. The erection of the New Jersey side span was finished on January 8th last, and that of the New York side span on January 21st.

THE APPROACHES.

During the period between April 1st, 1930, and

FIG. 6—METHOD OF ATTACHING SUSPENDER ROPES TO FLOOR BEAM

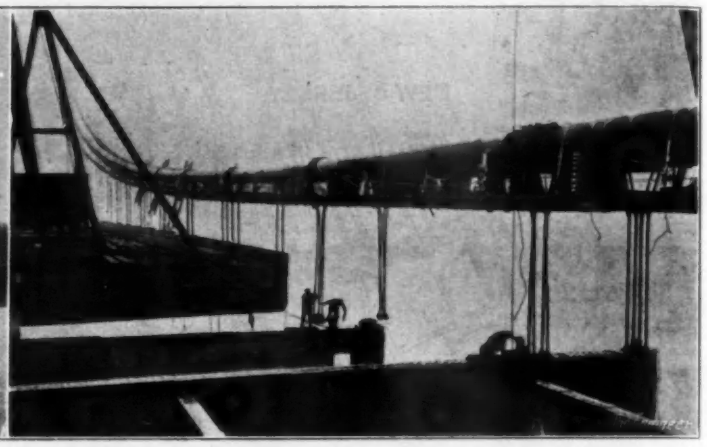


FIG. 7—ATTACHING SUSPENDER ROPES TO FLOOR BEAMS

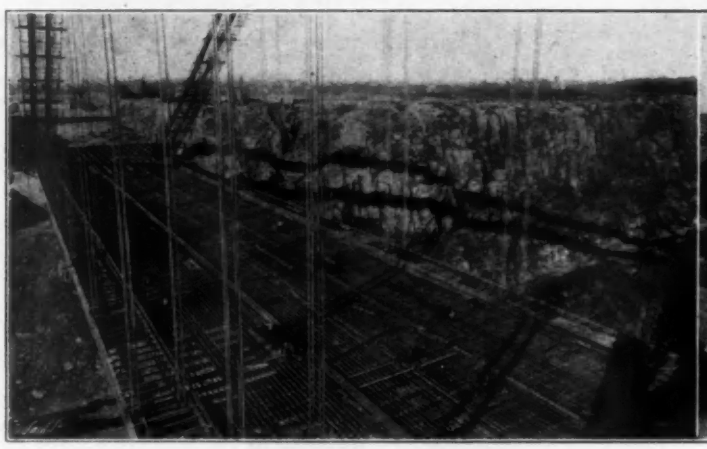


FIG. 8—NEW JERSEY SIDE SPAN FLOOR STEEL, FEBRUARY 3RD, 1931

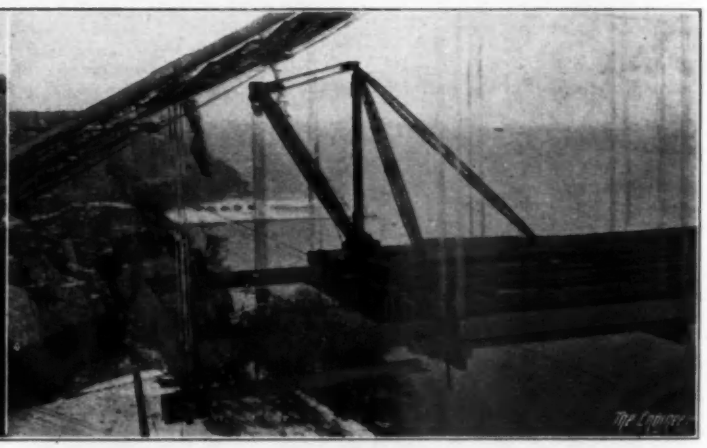


FIG. 9—ERECTING NEW JERSEY SIDE SPAN FLOOR STEEL

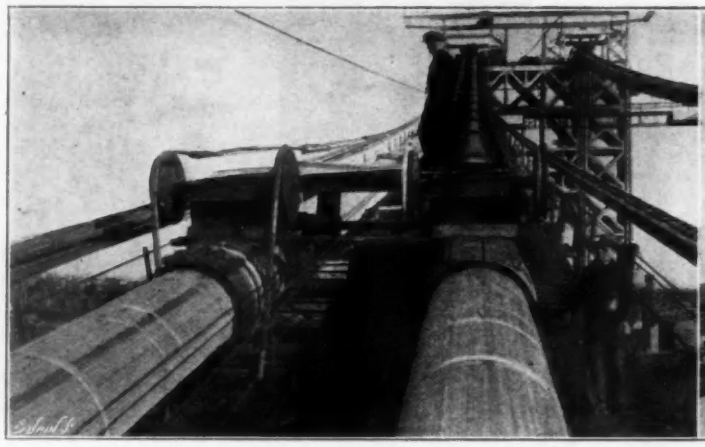


FIG. 10—PLACING SUSPENDER ROPE IN THE MAIN SPAN

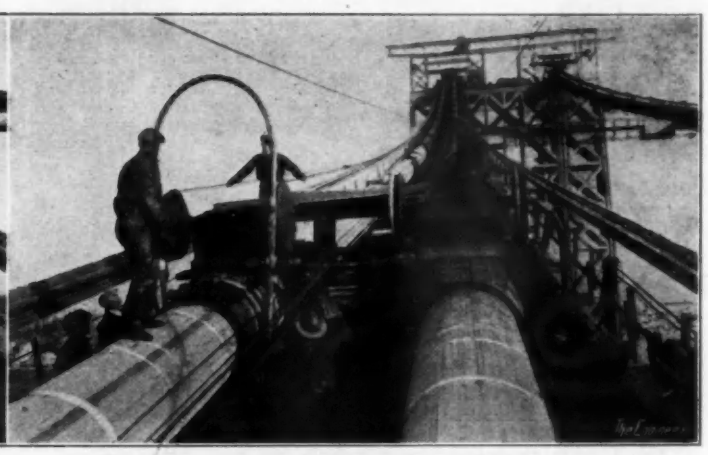


FIG. 11—LOWERING SUSPENDER ROPE INTO POSITION

THE HUDSON RIVER SUSPENSION BRIDGE, NEW YORK

(For description see page 590)

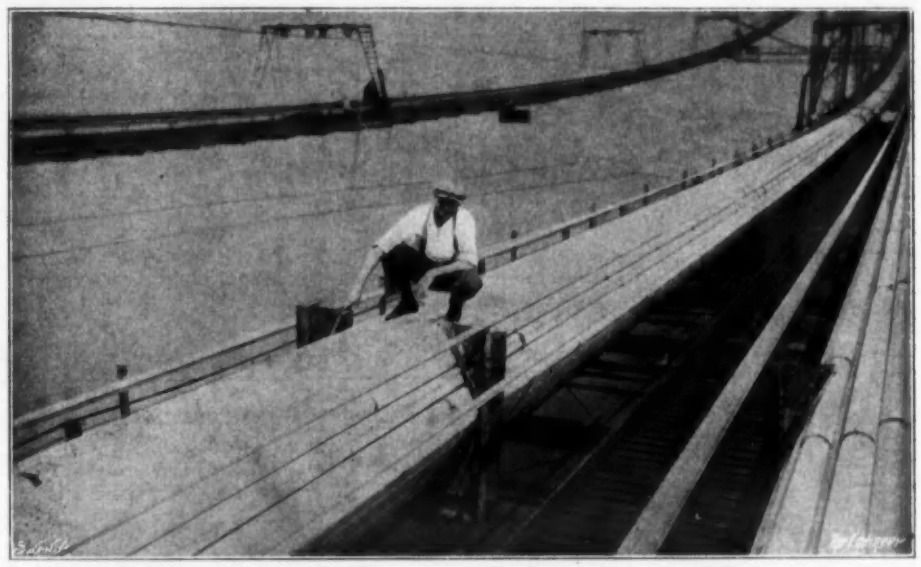


FIG. 12—ARRANGEMENT OF STRANDS IN UNCOMPLETED CABLE, JULY 16TH, 1930

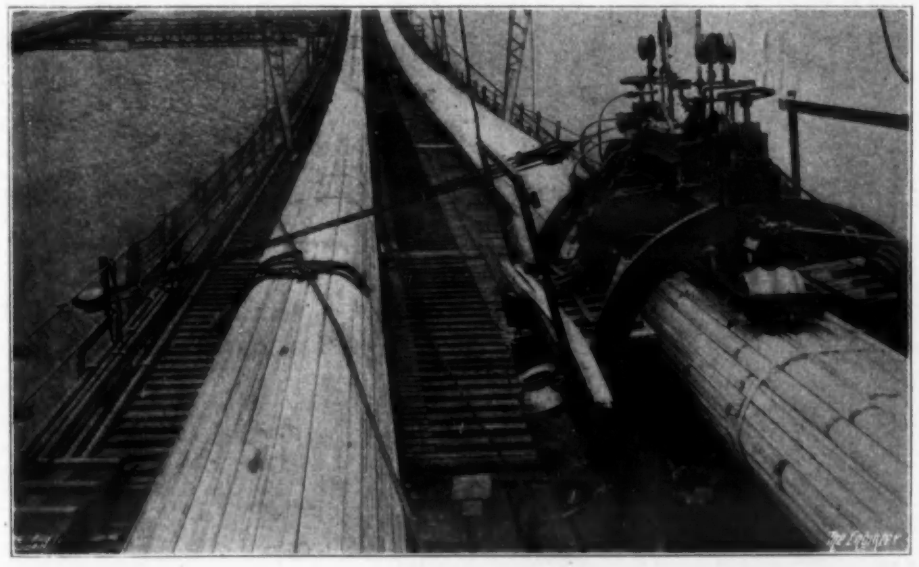


FIG. 13—PRELIMINARY CABLE COMPACTOR IN OPERATION

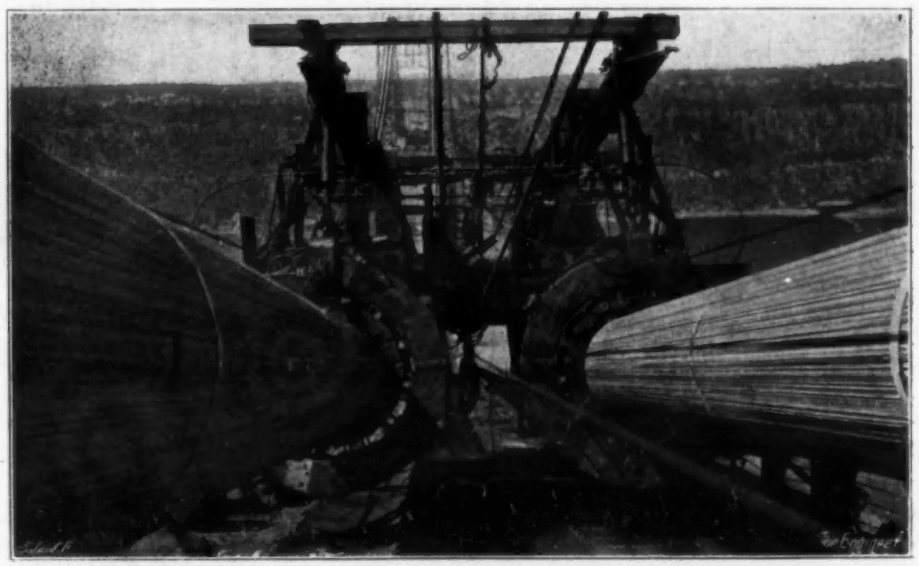


FIG. 14—FINAL CABLE COMPACTORS IN OPERATION

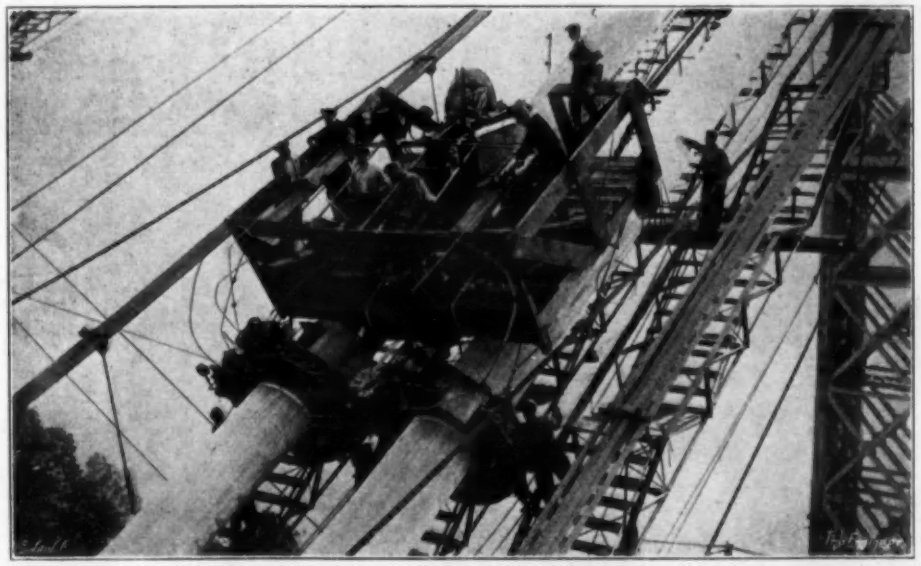


FIG 15—FINAL CABLE COMPACTORS ON NEW JERSEY SIDE SPAN

March 1st, 1930, construction contracts, together amounting in value to 4,256,711 dollars, were entered into as follows :—

	Dollars.
Main approach ramp of the New York Approach	746,679
Vehicular tunnel in West 178th-street	1,756,945
Riverside-drive connections of the New York approach	995,969
Excavation and miscellaneous construction for the New Jersey approach	287,651
Paving and miscellaneous construction for the New Jersey approach..	469,467

These contracts, together with those previously entered into, represent a total of 30,299,045 dollars for construction to the end of March last.

The arrangements for the New York approach are the result of elaborate and detailed studies on the part of the Port of New York Authority staff, and engineering representatives of the City of New York. An Engineering Committee, composed of Mr. Arthur S. Turtle, Consulting Engineer of the Board of Estimate and Apportionment of the City, and the Chief Engineer of the Port Authority, submitted two Reports concerning the New York Approach. The first Report recommended the apprpach plan as far as Broadway and including the Riverside-drive connections, while the second dealt principally with the plan for two vehicular tunnel approaches, one in West 178th-street and one in West 179th-street, between the sub-surface plaza at Fort Washington-avenue and the east side of Amsterdam-avenue, and recommended modification in the procedure of carrying out the entire approach plan. The plans were approved by the Board of Estimate and Apportionment, the Port of New York Authority, and the Governor of the State of New York.

An agreement between the City and the Port Authority to give effect to the plan for the New York approach was signed on July 30th, 1930. In it, provision is made covering the initial construction which must be completed before the bridge is opened for traffic. The vehicular tunnel in West 178th-street is to be ready for traffic, if possible, when the bridge is brought into service, but in any case not later than six months after that time. The vehicular tunnel in 179th-street, on the other hand, will not be constructed until after the bridge has been opened to traffic.

As initially constructed, the main approach ramp from the anchorage in Fort Washington Park will provide for a roadway 60ft. in width. It will be carried across Riverside-drive on a reinforced concrete arch bridge, of 196ft. span. The ramp rises on a 3·8 per cent. gradient to approximately street level at Northern-avenue, and continues underground east beyond Northern-avenue. West of Fort Washington it widens out to permit of connections being made with the vehicular tunnels which are to be constructed in West 178th and West 179th streets. The tunnel in West 178th-street, which is to be finished first, will initially provide for two-way traffic between Fort Washington and Amsterdam avenues.

As finally constructed, the main approach, from the anchorage to Pinehurst-avenue, will be widened to 145ft. by the addition of a ramp on each side of that initially constructed, the main arch over Riverside-drive being increased in width to accommodate the additional roadways. Vehicles to and from the Riverside-drive connections will then use the additional 30ft. roadways thus provided on the main ramp and will emerge in Pinehurst-avenue, rather than at Northern-avenue. The tunnel in West 179th-street will be constructed and the centre ramp will be extended up from the sub-surface plaza west of Fort Washington-avenue to provide entrances and exits at Broadway.

The plan for the New Jersey approach and highways connections was developed by an Engineering Committee composed of Mr. Jacob L. Bauer, State Highway Engineer to the New Jersey State Highway Commission; Mr. R. P. McClave, County Engineer of Bergen County; Mr. S. Wood McClave, Engineer of the Borough of Fort Lee; and Mr. Ammann, as representing the Port of New York Authority. Briefly, it involves a main approach ramp from the face of the Palisades passing over Hudson-terrace and coming to the surface east of Lemoine-avenue, where a spacious plaza with toll collection facilities will be provided. From this plaza direct street connections are made with Lemoine-avenue, Hudson-terrace and intermediate streets. From the easterly side of Hudson-terrace, special ramps to the main bridge approach make additional direct connection between that street and the bridge. From the plaza, the main approach passes westward under Lemoine-avenue and thence continues as a depressed roadway west under Center-avenue, Linwood-avenue and Fletcher-avenue. Between Lemoine and Fletcher avenues connection is made with the State Highway Routes Nos. 1, 4 and 6. An agreement has been entered into between the State Highway Commission and the Port Authority whereby the portion of the approach west of Lemoine-avenue to its connections with the various State highways will be built by, and be under the jurisdiction of, the State Highways Commission.

Research.

During the year under review, the research work, mention of which was made in the Third Progress Report, consisted principally in continuation of the strain measurements started in 1929 to determine the intensity and distribution of stress in the steel members in the New York Tower and in the eyebars anchoring the cables in the concrete of the New York Anchorage. In addition, measurements were made on one of the main cables, adjacent to the tower saddle, to determine the magnitude of the bending stresses in the cables at that point during the various stages of floor steel erection. A series of measurements, during construction, was also started to determine strains in the reinforced concrete arch over Riverside-drive. These tests also included observations of setting and curing temperatures in the arch concrete and contemporaneous laboratory measurements of plastic flow in small reinforced concrete columns.

The following is a list of the construction contractors and the work on which they were engaged during the year 1930 :—

John A. Roebling's Sons Co...		Cables and anchorage steel work
The McClintic-Marshall Co. ..		Towers and floor steel
The Cornell Construction Corporation		Main approach ramp of the New York anchorage
Ditto.	Ditto.	Vehicular tunnel in West 178th-street
The William P. McGarry Co.		Riverside-drive connections of the New York approach
George M. Brewster and Son, Inc.		Excavation and miscellaneous construction for the New Jersey approach
Ditto.	Ditto.	Paving and miscellaneous construction for the New Jersey approach

Our Illustrations.

The half-tone engravings accompanying this article have been reproduced from the illustrations given in the Report. At the head of the article on page 590, there is a view of the bridge, showing the floor steel erection completed, which was taken on January 21st last. Fig. 4 is a view of the main span floor steel erection seen through the lower portal of the New York Tower. The photograph from which it is reproduced was taken on December 13th last year. Fig. 5 shows the condition of the floor steel erection on December 10th, 1930. In Fig. 6 is seen the method of attaching the suspender ropes to a floor beam, while Fig. 7 shows the attaching of suspender ropes to floor beams at the centre of the main span, the view having been taken on December 26th, 1930. The floor steel of the New Jersey side span as it was on February 3rd, is seen in Fig. 8, while a view showing the method of erection in that span is given in Fig. 9. The series of views given on page 593 have to do with cable compacting. Fig. 12 shows the arrangement of the strands in the uncompleted cable on July 16th, 1930. One of the preliminary cable compactors is seen in Fig. 13, while two views of the final cable compactors are given in Figs. 14 and 15. Finally, Fig. 10, herewith, shows the erection of a suspender rope in the main span, the ends being passed over wooden sheaves, while Fig. 11 shows the lowering of a suspender rope into position.

French Colonial Motor Fuels.

The necessity of a country being able to rely upon its own fuel supplies has been so strongly emphasised by past events that in France, which is badly off in this respect, an investigation has been made into every possible means of remedying its deficiency by making the best use of whatever kinds of fuel there may be available. During the International Colonial Exhibition congresses will be held dealing with the different kinds of fuels and their applications to motor vehicles and for other purposes, while demonstrations will be organised to show the practical results obtained. The first meetings last week were intended to give a summary of the situation, particularly with regard to fuel supplies in the Colonies. When the urgency of the problem first began to manifest itself the French Government expected to find a satisfactory solution in alcohol from beet, which would at least partly supersede petrol and allow of a considerable development of the beet growing industry. It is unnecessary to repeat the many reasons why alcohol failed as a fuel for internal combustion engines, alike in France and in other countries, and even the attempt to render the use of alcohol compulsory by obliging importers of petrol to purchase from the State a quantity of alcohol equal to 10 per cent. of the petrol imported in order to ensure the general employment of a "national fuel" had to be abandoned. So long as alcohol is burdened with heavy excise duties it simply cannot compete with petrol. For the time being, alcohol as a fuel for internal combustion engines is under a cloud. It is by no means abandoned, because alcohol is regarded as the real national fuel, in the sense that it is essential to the development of beet cultivation which is of the greatest importance to agricultural prosperity. Every effort will continue to be made to secure a place for alcohol as a fuel. It was suggested even that a mixture of alcohol and glycerine from vegetable oils might be a suitable lubricant.

Vegetable oils are debarred from industrial uses on account of their acidity, and the catalytic method of obtaining motor spirit from such oils, while technically successful, has failed commercially. Petrol from vegetable oils costs twice as much as the imported product. The only thing that can be said at present is that the catalytic production of motor spirit is possible in cases of emergency. The country will no longer find itself entirely deprived of motor fuel in the event of its being cut off from foreign supplies. Charcoal suction gas is another fuel which seems to have been at a standstill during the past few years, but the absence of a more extended application of suction gas does not imply that no advance has been made. One cause of the slow progress of new fuels is that they were introduced with a flourish of trumpets and with claims that failed to be justified. Users were led to expect too much from them. The fault was not in the fuels themselves so much as in the methods of employing them, and while users have for the most part dropped the suction gas vehicle, because petrol can always put a stop to less efficient fuels that do not provide a big overall margin of economy, makers of engines and suction gas plants have been steadily working out a solution of the problem. Panhard and Levassor have adapted the high-speed engine to suction gas, and makers of wood carbonising plants are devising generators on more rational lines. Progress is being made slowly and surely in the way suggested by experience. In the Colonies there are regular services of charcoal suction gas vehicles, and in France a number of such vehicles are in operation. Still, charcoal suction gas has many drawbacks for automobiles which are not retrieved by its economy. Under normal conditions suction gas has a formidable competitor in heavy oils. In France the cost of fuel oils may be adapted by fiscal measures to national requirements, and in the Colonies carbonised wood will always be the cheapest fuel. In the designing of new suction gas plants the troubles, such as irregularity in operation, revealed by experience are being eliminated, and at the Congress importance was attached to the rapid production of gas by the blowing of air through the incandescent mass. The suction gas generator is being developed along new lines in the light of knowledge already acquired with the running of suction gas vehicles. Makers aim at producing smaller and lighter generators capable of working with greater regularity. It is claimed that the complete suction gas equipment for a 3-ton lorry can now be reduced to 300 kilos.

The trouble with charcoal lies partly in the fuel itself. The absorption of moisture in the humid atmosphere of the Tropics is a serious difficulty in some Colonies. It is also a drawback in France, where the user of charcoal often pays for an unduly high water content. The carbonisation of wood is not sufficiently economical unless it is effected in works which utilise the by-products. They obtain practically four equal parts of charcoal, by-products, water and gas, and the by-products are, of course, the most valuable. For motor traction in the Colonies, and even in France, the user must be able to produce his own charcoal. Otherwise the home user is at the mercy of irregular supplies and varying prices. Therefore wood carbonising plants are being improved in the same way as the other suction gas vehicle equipment. New systems of carbonising plants were presented at the Congress. They are designed upon more scientific lines than the old appliances and there is no doubt that if little advance has been made in the actual use of suction gas vehicles the progress being accomplished in engines and generators is preparing the way for a more extensive employment of suction gas lorries in the future.

Attempts are being made to avoid the inconveniences of charcoal by substituting for it torrefied wood, and this appears to have improved considerably the prospects for the suction gas vehicle. The really encouraging results obtained so far are due to the experiments of Professor Dupont, of Bordeaux, who is associated with the Forestry Department in the Landes. He determined the conditions under which the wood should be torrefied so that it should preserve the heat units that are lost when the wood is carbonised in the form of charcoal. The operation is a delicate one, because the temperature must be maintained at between 270 deg. and 300 deg. Cent., during which time plaster or lime or some other ingredient is introduced to act as an absorbent of water contained in the wood. Monsieur Bourdet presented an apparatus for ensuring an automatic torrefication of the wood and a distillation of the cellulose without risk of its passing into the state of charcoal. For this purpose the wood is cut up small, which makes it still more convenient for suction gas plants. After treatment the wood retains its natural dry colour, without trace of carbonisation. One ton of green wood will produce 700 kilos. of torrefied wood, and the heat units given off by combustion are stated to be one-third more than those of charcoal. The cost of the torrefied wood is said to be approximately £2 per ton.

No mention was made in the reports upon the fuel situation of what is being done at the collieries, where, nevertheless, a good deal of interesting work is being accomplished. At the Bethune, Courrières and some other collieries there are works in operation producing oil from coal. So far, low-temperature carbonisation has been regarded as uneconomical because the coal is not sufficiently bituminous, and most of the experimental work is being done by catalytic methods.

A large silver mine is said to have been discovered near Hsuanhua, in the Chahar province of China.

The Machinery of the C.P.R. Liner Empress of Britain.

No. IV. *(conclusion).*[*]

AUXILIARY AND EMERGENCY GENERATOR SETS.

IN our last article we completed our description of the machinery in the main engine and boiler-rooms and illustrated one of the two 800-kW B.T.H. turbo-generator units in the forward engine-room. As already mentioned in our earlier articles, there are also four 450-kW B.T.H. generators, which are directly driven by two-stroke single-acting Fiat oil engines supplied by Fiat British Auxiliaries, Ltd., of Govan, Glasgow. These engines are placed in an auxiliary engine-room between the forward main engine-room and the after boiler-room and are complete with their own arrangement of pumps and some other auxiliary appliances. They each have a designed output of 660 B.H.P. at 260 r.p.m The cylinders are four in number with a bore of 400 mm., or 15¾in., and a stroke of 500 mm., or 19 11/16 in., the main piston speed being about 850ft. per minute. Our illustration Fig. 23 shows one of the engines and illustrates the grouping of the controls at the fly-wheel end of the unit above the scavenge pump. The fuel injection air is supplied by a double-acting compressor at the opposite end of the engine, the arrangement of the scavenge pump and compressor materially assisting the balancing of the moving parts, and giving a noticeable freedom from vibration. Each engine is complete with its own water and forced lubrication pumps.

The emergency lighting units are accommodated in a special room on one of the higher decks. They comprise two 70/75-kW generating sets, each consisting of a standard six-cylinder paraffin engine built by the Parsons Oil Engine Company, Ltd., of Southampton, the cylinders being 7in. bore and 8in. stroke, designed to give a continuous output of 115 B.H.P. at 750 r.p.m. The engine is of the totally enclosed type and provided with ample inspection covers for access to all working parts. One of these sets is shown in Fig. 24. Forced lubrication is fitted throughout. Ignition is provided by a high-tension magneto with an impulse starter, and there is also a battery-coil system as a standby. The engine is put into operation by an electric starter working on 50 volts, while a geared-down hand starter working in conjunction with the half-compression cocks is also fitted. The water circulating pump is mounted on the engine, and it not only circulates the water through the cylinder jackets, but also around the crank case base, thereby permitting of extended running without any undue heating of the lubricating oil.

The direct-coupled generators were built by W. H. Allen, Sons and Co., Ltd., and are of the single-pedestal bearing type, each having a continuous output of 75 kW at 220 volts.

The fuel supply is furnished from a large paraffin tank mounted above the engine-room, which is of sufficient capacity to cover thirty-six hours' continuous run. Cooling for the engine circulating water is provided by a Heenan and Froude marine type cooler, which is mounted on the after deck. The cooling fan is electrically driven from the engine generator and is entirely automatic in action. There is also an additional circulating pump built into each cooler, while steam coils are provided in order to overcome the effect of frost.

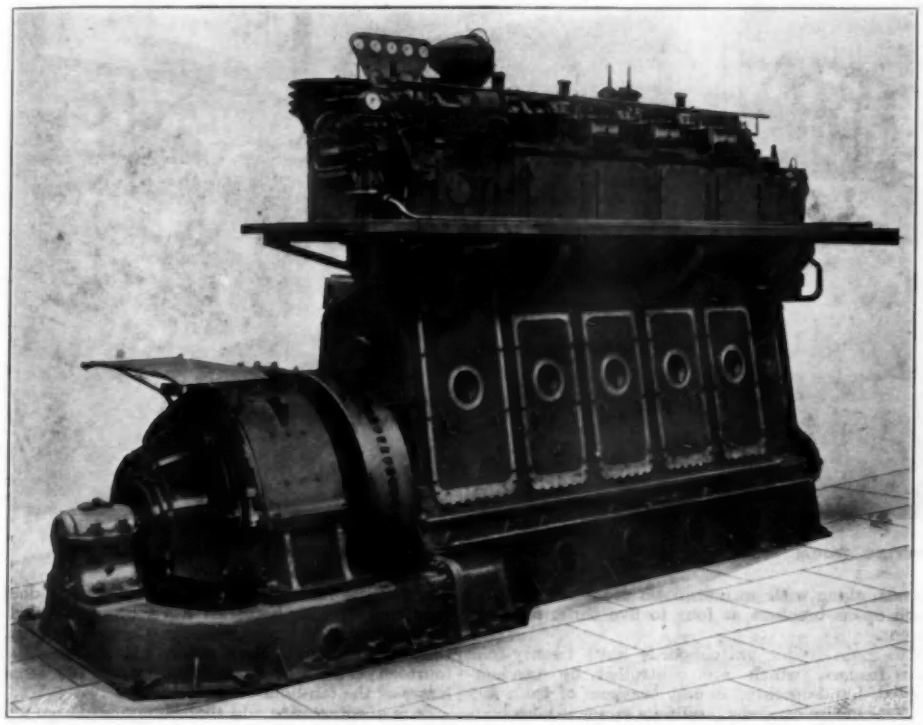


FIG. 23—ONE OF THE FOUR FIAT-B.T.H. 450-KW GENERATOR SETS

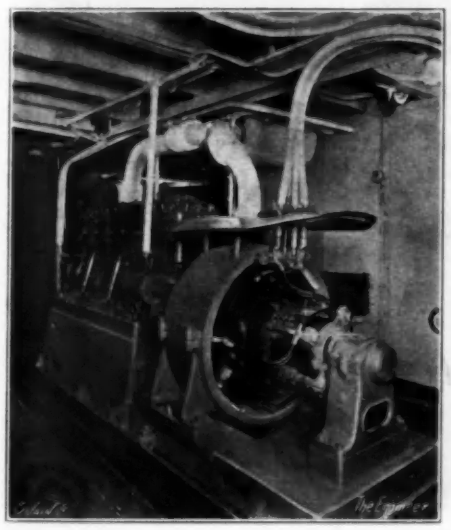


FIG. 24—EMERGENCY GENERATOR SET

SWITCHBOARD ROOMS AND SWITCHGEAR EQUIPMENT.

The system of control and distribution of the electric power adopted in the vessel has been specially designed to secure a continuous supply even under abnormal conditions, this being necessary since such equipment as the steering gear, engine-room auxiliary machinery, &c., is driven electrically. The two main switchboard rooms—see Fig. 25—are separated from each other by a water-tight compartment, and the port or outer room has a similar compartment between it and the ship's side. The danger of damage due to collision is thus reduced to a minimum, and either of the switchboard rooms can supply current to any part of the vessel.

The main scheme of distribution is on the ring main principle. Two 450-kW oil engine driven generators and one 800-kW turbo-generator, already referred to, feed into the port generator switchboard, and a similar group of generators feed into the starboard main generator board. Bus-bar coupling switches make the bus-bars common throughout—that is, all six generators feed into a common bus-bar or isolate the three port from the three starboard generator panels.

Similarly, isolating switches, on the port and starboard main generator switchboards, control the supply to the main feeder switchboards, which again have bus-bar coupling switches which isolate or make common their bus-bars, as may be desired. It is thus possible, in case of necessity, for either the port or starboard main boards to supply the port or the starboard main feeder switchboards separately or combined. By this means either of the main generator or feeder switchboards can be made "dead" and safe for working on during repairs, adjustment or cleaning operations without interference with the ship's normal supply.

The main feeder switchboard gives a dual supply, namely, port and starboard feeds to four ring mains of 400, 800, 1000 and 1200 ampères capacity, and also four other circuits, each of 1500-ampère capacity. A direct supply is also given to the steering motors, the engine and boiler-room lighting circuits, and the main circulating water pumps, &c.

There are several auxiliary feeder and sub-distribution switchboards in the various ring main circuits, which supply over 220 distributing points. These are designed to receive current from either the port and the starboard feeder switchboards through the ring main system.

The emergency supply from the two 75-kW paraffin sets—see Fig. 24—and also the panic battery supply are controlled by a special emergency switchboard. The purpose of the panic battery is to maintain the supply to the boats, the navigating instruments and other necessary lighting circuits for that period which elapses between a total shut-down of the main generators and the starting up of the emergency generators. The scheme is designed to be wholly automatic in its action, the panic battery coming into use by means of a change-over switch operating on the failure of the voltage on the main bus-bars. Arrangements are made for charging the battery from either the main or emergency generators, and also for discharging, in order to maintain its efficiency over what would be normally out-of-use periods.

The panic battery, which is housed in a special self-contained compartment, consists of 180 "Nife" nickel-cadmium alkaline cells, supplied by Batteries, Ltd., of Redditch. Its capacity is 220

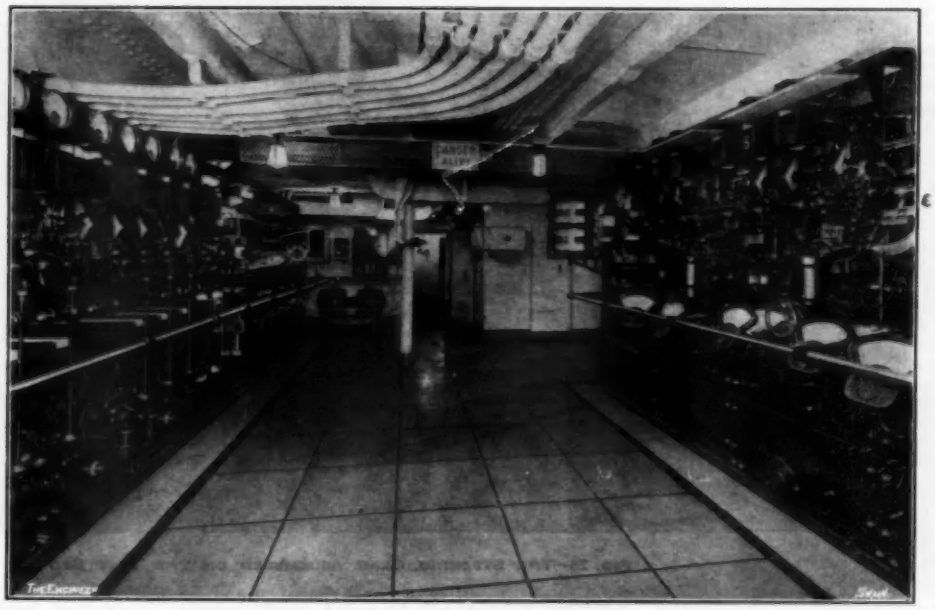


FIG. 25—SWITCHBOARD ROOM ON THE PORT SIDE OF THE SHIP

[*] No. III. appeared May 22nd.

ampère hours, and the battery has a separate charging board and a motor-generator charging set.

The main switchboard equipment comprises two main generator boards, each 14ft. long; two main feeder switchboards, each 15ft. long; seven principal auxiliary switchboards, open type; an emergency and panic battery switchboard; eight secondary auxiliary switchboards, totally enclosed; and the low-power switchboard, all of which have been supplied by Whipp and Bourne, Ltd., of Castleton, near Manchester. The firm's new contactor pattern pressure-contact marine fuses have also been installed.

thereby relieving the generators of a large proportion of their load. This arrangement is particularly desirable in the case of a generator shutting down involuntarily when running in parallel with other generators, thus tending to overload the machines remaining on the bar, with the probability of their breakers being tripped out. A similar risk arises when the running machines become loaded beyond their normal capacity.

Whenever the emergency trips operate audible alarm and signal lamp indications are given. The normal overload trips have a time lag of twenty

With the extensive development of the telephone, cabin bell and fire alarm systems, &c., the demand for a low-power supply has been increased considerably. A separate switchboard is installed for supplying these circuits, which are fed from either a Crypto motor generator set supplied by the Crypto Electrical Company, Ltd., of Willesden, London, or from duplicate storage batteries. The Crypto motor-generator has been specially designed for charging these batteries as well as supplying the switchboards. The generator runs with a shunt winding when charging, and compound when feeding the switch-

FIG. 26—WIRELESS RECEIVING AND TRANSMITTING ROOM

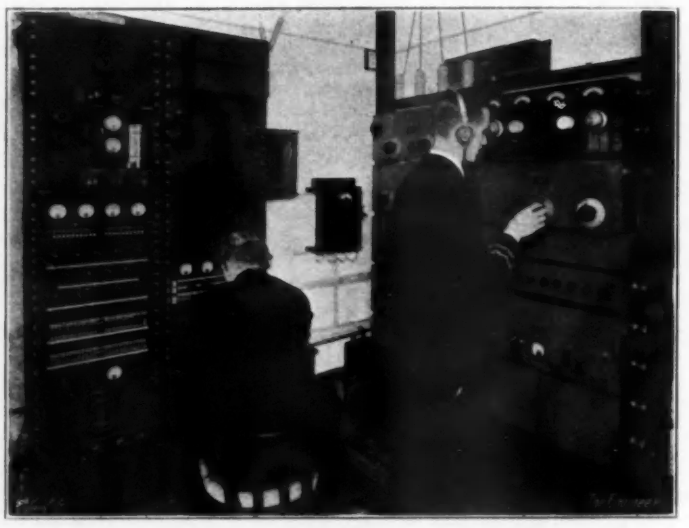


FIG. 27—WIRELESS TELEPHONE RECEIVING ROOM

As Fig. 25 indicates, the main generator and feeder switchboards are housed, facing each other, in two special compartments aft of the main engine-room, the attendants having a full view of all the instruments and circuit breakers.

Each of the six generator panels is equipped with main circuit breakers, sector pattern ampère, kilowatt meters and voltmeters, which have an adjustable tilting device for easy reading, also rheostat controls, pilot lamps, and paralleling plugs. Arrangements are made for the graphical indication of the total load on

seconds, along with an automatic dead short release which opens breakers at four to five times full-load current.

The main feeder switchboards have twenty-four main feeders, which are controlled by tandem-coupled, hand-operated circuit breakers of from 400 to 1500-ampère capacity, and four minor feeders controlled by knife switches and fuses. There are eight control switches with indicator lamps designed to operate the remote-controlled incoming feeder breakers on the four principal ring main auxiliary

board. The feeder circuits are protected by double-pole fuses. The batteries have been supplied by the Chloride Electrical Storage Company, Ltd., of Clifton Junction, Manchester. Each consists of fourteen cells, having a capacity of 100 ampère-hours at the ten-hour rate of discharge.

It is of interest to add that ebony Sindanyo panels have been used throughout the main and auxiliary switchboard equipment, in place of the usual enamelled slate panels. This material, it may be stated, is less than half the weight of enamelled slate

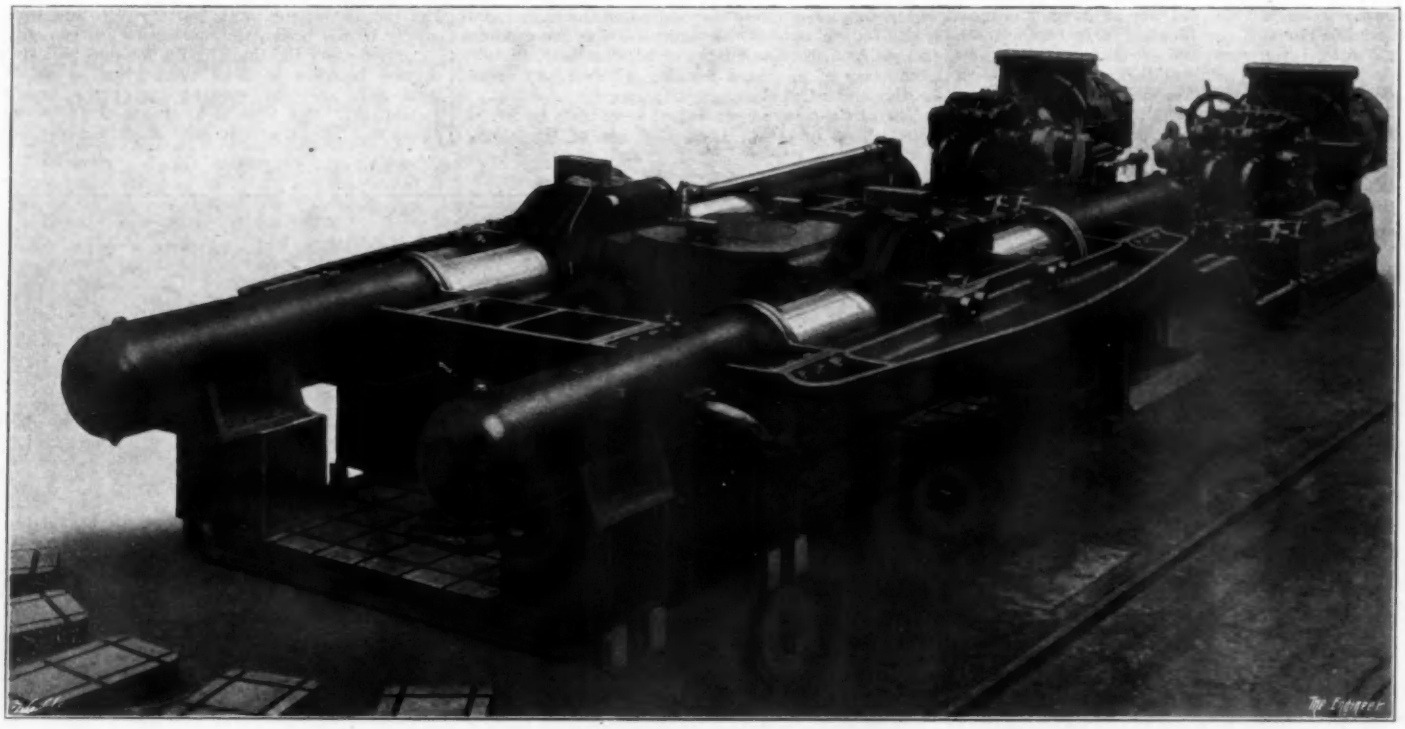


FIG. 28—THE STEERING GEAR ASSEMBLED ON THE TEST BED AT THE MAKERS' WORKS

either forward or after section, and kilowatt-hour meters are also provided.

The main breakers have the usual overload with time lag and reverse current releases. The positive and equaliser poles are mechanically coupled for hand control, the negative pole being electrically operated by a solenoid and controlled by a switch, which is conveniently placed for use in paralleling.

In order to maintain the supply in the event of abnormal conditions, special instant-action emergency overload trip relays have been provided, and these operate at a predetermined load to trip out certain selected feeder circuits of secondary importance,

switchboards; hand operation is provided locally. The steering gear motor starters and switches occupy the extreme end panels, while shore connection terminals are provided for shore supply when the vessel is in dock. Pilot and earth testing lamps, together with bus-bar coupling switches, are also fitted.

All the principal auxiliary switchboards have tandem-coupled hand-operated circuit breakers, fitted with overload time-lag release for principal circuits and double-pole knife switches and fuses for smaller circuits; while the minor auxiliary and sub-distribution boards, which are totally enclosed in steel casings, have knife switches and fuses.

panels, and is a product of Turner's Asbestos Cement, Ltd., of Trafford Park, Manchester.

MOTOR CONTROL GEAR.

In a vessel as large as the "Empress of Britain," depending upon electricity for many essential services, the control gear for the various electric motors forms an important item of the auxiliary electrical equipment. Brookhirst or Allen-West marine type control gear is installed for the control of the electric motors driving the various engine-room auxiliaries, forced and induced draught fans, Diesel oil fuel pumps, motor-driven oil fuel transfer pump, and battery-

charging sets. The control panels for this unit embody the special features required by the Canadian Pacific Steamships, Ltd., such as isolating switches on each control panel and emergency operation for the electrically operated circuit breakers.

Some of the largest starters are those for the main circulating pumps; they are of the Brookhirst multiple lever pillar type.

Reference has already been made to the extensive lighting equipment supplied by the General Electric Company, Ltd. An interesting feature of the cabin lighting is the provision of a luminous point on each berth light, which enables the switch to be easily found in darkness. Instead of the usual bell indicators, a luminous cabin indicator system has been employed. The telephone system includes instruments of the Graham multi-phone type for executive and intercommunication purposes. There is also a manual exchange board and an automatic exchange board for cabins and ship's *personnel*. The telephones last mentioned are of the Strowger automatic disc type and the system is interconnected with the passenger manual system with the shore, and with the Marconi short-wave telephone system. The telephones above referred to were supplied and fitted by the Automatic Telephone Manufacturing Company, Ltd., of Liverpool.

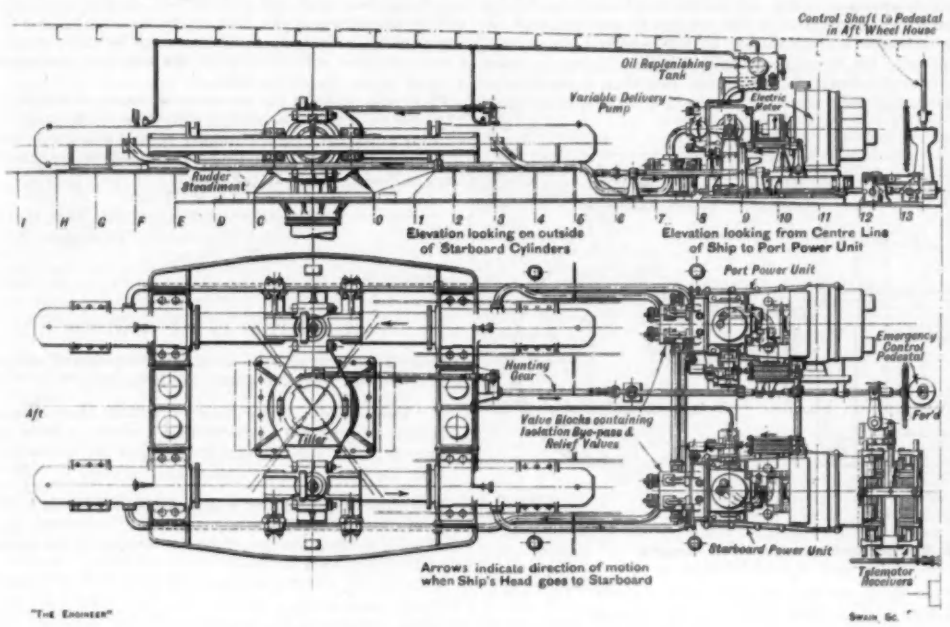

Control Shaft to Pedestal in Aft Wheel House
Oil Replenishing Tank
Variable Delivery Pump
Electric Motor
Rudder Steadiment
I H G F E D C 0 1 2 3 4 5 6 7 8 9 10 11 12 13
Elevation looking on outside of Starboard Cylinders
Elevation looking from Centre Line of Ship to Port Power Unit
Port Power Unit
Emergency Control Pedestal
Hunting Gear
Aft
Valve Blocks containing Isolation By-pass & Relief Valves
For'd
Tiller
Starboard Power Unit
Arrows indicate direction of motion when Ship's Head goes to Starboard
Telemotor Receivers
"The Engineer"

FIG. 29—GENERAL ARRANGEMENT OF STEERING GEAR

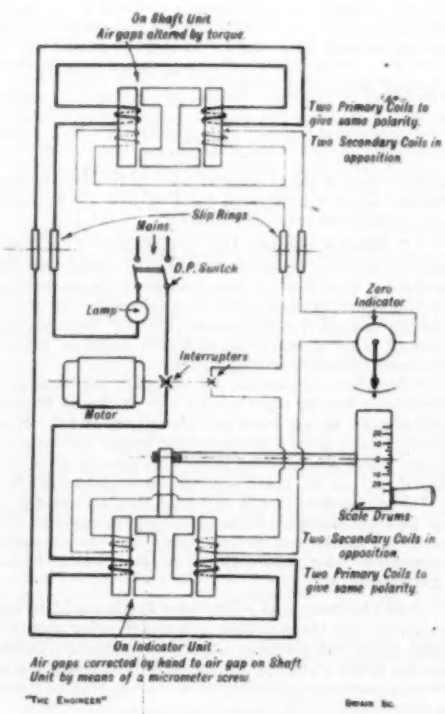


FIG. 30—TORSIONMETER CIRCUIT

THE WIRELESS EQUIPMENT.

A very complete wireless equipment, which includes the latest developments in telegraphy and telephony, direction finding, and broadcasting practice, has been designed and supplied by the Marconi International Marine Communication Company, Ltd., of Marconi House, Strand, London, W.C. 2. The two views reproduced in Figs. 26 and 27 show parts of the wireless telegraph and telephone apparatus respectively.

Fig. 26 is a view of the receiving equipment for the 2-kW valve transmitters, shown on the left, with the emergency transmitter beside it at the top right hand. The receiving equipment for all wave-lengths from 15 m. up to 20,000 m. is shown at the centre of Fig. 26, while to the right there is Marconi direction-finding gear. The charging boards and the aerial switch gear are conveniently placed for the use of the operator, and the installation includes a special design of transmitting key for desk use. The main motor generator sets are placed in the centre main switchboard room, the whole of the wireless equipment being housed in four large cabins, three of which are on the top deck. A view in the wireless telephone receiving room is reproduced in Fig. 27. Immediately in front of the operator there is to be seen the monitoring switchboard, which controls the terminal equipment panels shown on the left, to which the wireless receiver is connected. The monitoring switchboard is, in turn, connected to the ship's telephone system, permitting the putting through of wireless telephone calls. The range of the equipment may be judged from the fact that using London as a connecting link, communication can be established with practically every telephone subscriber in Europe, while *vid* New York, calls on the telephone system of Canada, America, Mexico, and Cuba can be made. The direction-finding gear has a fixed-frame aerial and is worked in conjunction with the Sperry gyro compass and repeater gear. Marconi wireless equipment is also fitted to certain lifeboats.

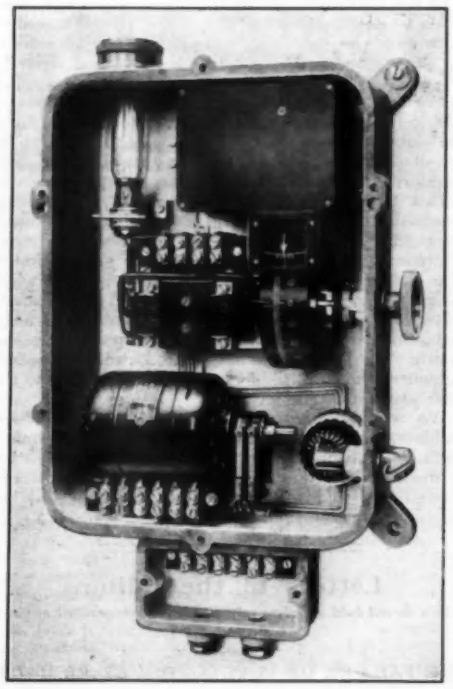


FIG. 31—TORSIONMETER INDICATOR UNIT

THE STEERING GEAR.

An important part of the electrically operated navigating equipment is the steering gear, which is of special interest on account of its exceptionally high power, and the fact that, according to the makers, it is the largest yet constructed. It operates on the electro-hydraulic principle, and follows in its design the established practice of its builders, Brown Brothers and Co., Ltd., of Edinburgh. The unusual dimensions of the gear—it may be recalled that the diameter of the rudder stock is 26½in.—necessitated a departure from usual mercantile marine practice and the adoption of an arrangement similar to that employed for large naval vessels. As our illustrations indicate, the power units are mounted on the deck forward of the rudder gear itself. Fig. 28 shows a view of the gear assembled on the test bed at Rosebank Ironworks, Edinburgh, while a general arrangement drawing is reproduced in Fig. 29. The essential part of the gear comprises two sets of opposed-hydraulic cylinders, the rams of each pair of cylinders of which are coupled together and are connected by swivel blocks to the tiller mounted on the rudder stock. There are, as shown in Fig. 29, two power units, each consisting of a constant-speed non-reversing Laurence Scott motor driving a Williams-Janney variable-delivery pump, the pump controls being operated from the bridge by Brown's patented telemotor gear. The hydraulic system is kept fully charged with oil, for which a replenishing tank is provided. Movement of the steering wheel causes the pump to deliver oil under pressure to one or other of the pairs of hydraulic cylinders, as may be required, the oil discharged from the opposing cylinders being passed to the suction side of the pump. As our drawing indicates, a floating control and hunting gear forms part of the mechanism, and is designed to cause the steering gear to move in direct relation to the movement of the steering wheel, and to stop the pump delivery whenever the position of the rudder corresponds with the wheel position. When the rudder is stationary in any position, the motor is running light. Each of the two power units is designed to perform the full duty, but normally only one is in action. The second or reserve unit can be brought into action instantaneously by starting up the motor, and when manœuvring or docking, under which conditions, extra quick steering may be found desirable, both units are run together, thereby doubling the speed of the gear.

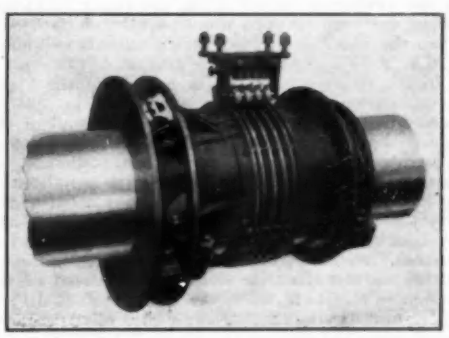


FIG. 32—SHAFT PORTION OF TORSIONMETER

In the very remote event of any damage to the ship's structure disabling the gear on one side of the ship, the machinery is so arranged that the set of cylinders on that side of the ship can immediately be cut out and the gear worked with the remaining two cylinders. The telemotor gear is duplicated in a similar manner, there being two transmitters on the bridge, each with an alternative steering position on the overhead compass platform, and two receivers in the steering compartment. In addition to these positions, a mechanical control from the after wheel house is provided, along with an emergency position in the steering gear compartment itself. Mention may be made of the rudder steadiment with its thrust bearings for the radial thrust of the rudder post and the bearing carrying the weight of the rudder along with its post and the tiller. This is a massive steel casting with phosphor bronze bearings. The gear, which we inspected in the shop, is a fine example of engineering construction, and noteworthy for its large size and power. Throughout the trials of the ship the excellent steering qualities of the vessel were consistently shown.

POWER INDICATING EQUIPMENT.

An important part of the power indicating equipment is the Siemens-Ford torsionmeters, which are shown on page 510 *ante*, and fitted on all four shafts. This gear was invented by Mr. W. J. Ford, one of Dr. Drysdale's assistants at the Admiralty Laboratory, Teddington, and is built for a wide range of uses, both land and marine, by Siemens Brothers and Co., Ltd., of Woolwich. It is designed to indicate the mean torque on the shaft, and for investigation purposes it can also be built to give the instantaneous value of the torque at any point in the

revolution, thus enabling a curve of cyclic fluctuations to be obtained.

The indications are given electrically and are based on the principle that an alteration in the width of an air gap in the magnetic circuit of a transformer causes an alteration in the E.M.F. of the secondary winding. In the torsionmeter, the torsion of the shaft is made to alter the air gaps of a special type of balanced transformer mounted on the shaft, no multiplying gear being required.

Referring to the diagram, Fig. 30, it will be seen that the transformer is of the differential type, with two sets of windings and double air gaps, one air gap being increased whilst the other is decreased, this being made possible by the attachment of one part of the transformer to the collar casting and the other to the sleeve casting, as shown in Fig. 33. The E.M.F.'s of

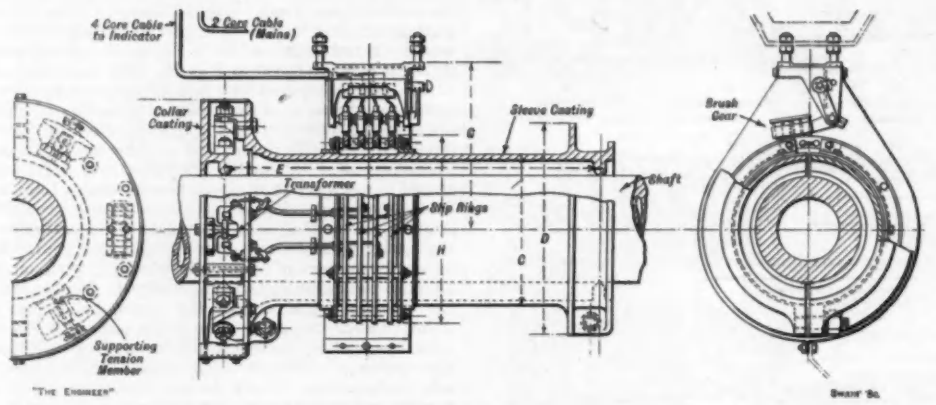


Fig. 33—General Arrangement of Torsionmeter on the Shaft

the two secondary windings are in opposition, so that when the two air gaps are equal, corresponding to a "no torque" condition of the shaft, no current flows in the completed circuit of the secondary windings. When the two air gaps are unequal, which occurs when the shaft is twisted, the resultant secondary E.M.F. gives a measure of the amount of torsion.

In the receiver or indicator portion of the apparatus, shown in Fig. 31, which can be placed in any convenient position, such as the wall of the tunnel shaft compartment, there is a second set of differential transformers exactly similar to that on the shaft. In this second set, the air gaps are alterable by hand, and this set is electrically connected to the first set in such a manner that the effects in the secondaries of the two transformer sets oppose one another. Assuming that the air gaps of the transformer on the shaft are unequal by reason of the torsion of the shaft, there will then be an E.M.F. in the secondary circuit. If the air gaps of the receiver transformer are adjusted to be the same as those on the shaft transformer, an equal and opposite E.M.F. is generated, and no current will flow. The zero-indicating instrument in the circuit shows this condition, whilst a simple micrometer device enables the alteration made to the air gaps of the receiver transformer to be ascertained. The amount of this alteration is a measure of the torsion of the shaft, which in conjunction with the revolutions per minute and a constant, is convertible into horse-power. The movement of the zero-indicating instrument is so damped that it cannot oscillate owing to the variations of the twist during each revolution, but takes up a mean position.

A special feature of the indicating system is that it is designed so as to render the accuracy of the readings independent of supply voltage variations, and eliminates completely any possibility of error due to variations in the slip-ring brush contacts. The length and section of the connecting cable is immaterial, as the resistance factor does not enter into the result, while the readings are not dependent upon the constancy of ammeter or voltmeter calibrations.

As indicated in Fig. 30, the primary coils of the transformers are excited from a small motor-driven interrupter, fed with D.C. from the ship's mains, the power required being small, and current is only consumed when readings are being taken. A second interrupter operated by the same motor cuts out one phase of the secondary current, enabling a D.C. indicator to be used, which can be designed in a more robust manner than can an A.C. instrument, and is also directional in its reading.

Figs. 32 and 33 show the portions of the apparatus mounted on the shaft complete with transformers, slip rings and brushes for taking the current into and out of the transformers. A handle and lever is provided for lifting the brushes from the slip rings in order to avoid unnecessary wear when the gear is not being used. The brush gear can be carried from the top of the tunnel casing by means of the brackets indicated. One half of the casing is made to protect the brush gear and slip rings, and is removable for inspecting the gear, as also is the casing covering the transformer.

Two methods are available for setting the zero reading corresponding to the "no torque" condition of the shaft. Either the shaft can be slowly rotated by the motor-driven turning gear in the ahead and the astern directions, the mean reading being taken as the zero position, or the shaft may be trailed at a very slow speed, under which conditions there is no twist on it, and the zero position is at once given. This latter method was adopted on the "Empress of Britain," and the recording so obtained was calibrated at the end of each day's trials. After setting, the brushes are lowered into contact with the slip rings and the current switched on, the lighting up of the pilot lamp shown in the left-hand corner of Fig. 31 indicating that the current is flowing. When it is desired to read the power, the zero indicator pointer, which appears at the top of the scale window, will be found to be away from the central or zero position by an amount corresponding to the power being transmitted. By turning the milled knob the zero pointer is brought back to its central position, rotating the drum carrying the scale, and so giving a reading of scale divisions against the index pointer. The horse-power is then obtained from the formula

$$\text{H.P.} = \frac{\text{Scale reading} \times \text{r.p.m.}}{\text{Constant}}$$

The constant for the instrument is determined either from the direct calibration of the instrument by a torsional test or from its known dimensions, and the modulus of elasticity of the shaft material. It is of interest to learn that with the latest types of shaft and the more flexible characteristics of the newer steels a shorter torsionmeter, such as that shown in Fig. 32, can be employed. On the "Empress of Britain" once the torsionmeters were set the measurement of power under full and overload conditions was immediately proceeded with, and very accurate results were obtained.

In the four articles now concluded we have sought to give prominence to the more novel technical features of the machinery installation, but in so doing we have necessarily had to pass over or describe inadequately many features and details more familiar to our readers. It has not been possible to mention all the firms which have supplied individual parts of the plant, all of which were necessary to make up an installation which is worthy in every way of the highest standards of British marine engineering prestige.

The "Empress of Britain," which sailed from Southampton on Wednesday, May 27th, will certainly do much to make popular the St. Lawrence route between Europe and the North American Continent. The chairman and president of the Canadian Pacific Railway, Mr. E. W. Beatty, who arrived from Canada a few days ago, is making the maiden voyage with the ship, along with a full complement of passengers and mails. The Prince of Wales, who, it will be recalled, launched the ship, paid by air, a special visit to the liner just before she left.

We would express our thanks to the owners, builders, and sub-contractors, and their technical staffs, for their ready co-operation in the preparation of these articles, and the facilities which have been given to us to inspect personally the ship and her machinery installation.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE FAILURE OF FLAT-BOTTOM STEEL RAILS.

Sir,—Mr. Huddart's letter on the above subject in your issue dated April 3rd is not, I am afraid, less open to criticism than was his first article on the same subject.

In the first place, he states that "Mr Wraight has proved that the readiest method of detecting a lap is the Izod test, and that normalising decidedly modifies the line of directness of the flaw." Mr. Huddart appears to be under the impression that the hammer test is an Izod test, which is not the case. An Izod test is an impact test; but an impact test is not necessarily an Izod test. The latter test will not detect the presence of a flaw in the rail, and is not intended for such a purpose. The impact test to be incorporated in the British Standard Specification is, I understand, similar to the hammer test as carried out for some years past by this inspectorate.

The photograph No. 6 in Mr. Wraight's article is not the same section as that from which photograph No. 5 was taken, but was from an adjacent slice. Normalising has had no effect whatever on the lap, the very slight difference in the appearance of the flaw in the two photographs being merely the result of the photographs being taken from two positions in the rail. The flaw makes exactly the same angle with the edge of the rail in each photograph, and its line of direction has not been altered by normalising. Mr. Huddart's method of discovering lapped rails will not, I am afraid, result in many defective rails being discovered. A falling rail which strikes simultaneously with the flange and head will not necessarily disclose a flaw, the bending stress at the base of the web not being sufficiently large. The only satisfactory method is to employ a cut test piece, keep the foot of the rail rigid, and apply a blow to the side of the head.

It is still difficult to reconcile a tensile strength of 77¼ tons for a 0·47 per cent. C rail. The works figure of 47 tons must have been obtained on the rolled rail, and it is difficult to understand why the tensile figure should have increased nearly 70 per cent.

P. Hinde,
Assistant Metallurgical Inspector, Indian Stores Department, Tatanagar, B.-N. Railway, India.

April 28th.

VAPORISATION IN C.I. ENGINES.

Sir,—Your issue of April 10th, in a discussion of a paper by Davies and Giffen, contains the following:—

> "These results would seem to indicate that, as seen earlier, evaporation plays at most a minor part in the process; the rate at which heat can be transferred from the air to oil is the dominant condition."

The number of paths by which carbon can travel to the carbon dioxide condition appear to be numerous. Discussion of combustion may therefore not get us far unless a particular path is outlined.

Whether or not the combustion of oil fuel is possible without vaporisation may not be the vital issue confronting developers of compression-ignited engines. The real problem would seem to be to know what conditions to provide in order to insure combustion within an engine cylinder along a path suited to the achievement of desired engineering results.

One such path would seem to be combustion from the vapour phase rather than through a cracking phase with the probable appearance of material well suited to endure for a considerable time the temperatures of an electric arc.

Returning to the above quotation. To one of the vaporisation school of combustion, it does not seem entirely logical to minimise the problem of vaporisation while magnifying the problem of heat transfer, when it is possible that the heat of vaporisation of the oil is a rather large percentage of the total heat to be delivered to the oil. That there may be a limit to the rate at which an oil will vaporise—just as there is a critical velocity in the flow of steam—may merit consideration. If there is such a limit, then variation of the time lag of ignition is, in a measure, beyond our power. But to what extent?

Robertson Matthews.

Detroit, Mich., May 14th

THE "R 101."

Sir,—On page 115 of Appendix VI. of the Report of the "R 101" Inquiry, prepared by Professor C. E. Inglis, occurs the following:—

> "5. Having studied the possibilities of the ship merely floating under various conditions of gas bag deflation, consideration was next given to the question of the aerodynamic control available when the ship is driven forward at a constant air speed of 55 knots—her normal cruising speed—at different angles of pitch θ and with different elevator angles η.
>
> "Complete information on this point can be deduced from the figures supplied by the National Physical Laboratory, as set forth in Tables 1, 2, and 3. From these tables it is possible to determine the angle of pitch θ and the elevator angle η to provide at this air speed a given lift L and a given pitching moment M.
>
> "For instance, it will be found that an upward lift of 10 tons combined with a pitching moment of 3500 tons-feet can be achieved by flying the ship pitched up through 8·2 deg., and with the elevators turned 10 deg. downwards."

I should be very glad if Professor Inglis would be kind enough to reply through your columns showing how these results of lift and pitching moment are actually obtained from the tables published in Appendix VI., indicating the particular factors and equations which are used in obtaining the results.

E. F. Spanner.

London, E.C. 3, May 22nd.

The old bells of St. Budeaux Parish Church, Plymouth, have not been rung for some time now owing to the decay of the oak frame making it unsafe to use them, and they have been removed from the belfry for the purpose of being hung in a cast iron frame on a foundation of steel and fitted with ball bearings and all the latest devices of the bell-making art. The work, which is to cost about £500, is being carried out by a Loughborough firm, J. Taylor and Co., which was founded a century ago by a native of Buckland Brewer, North Devon.

Railway and Road Matters.

ANSWERING a question on May 13th, Mr. Morrison said that he had asked the principal railway companies to consider the report on main line electrification and to furnish him with their observations upon it as soon as they could.

DURING the last ten years the combined staffs of the London "Underground" group have increased from 33,000 to 46,000, an advance of 39 per cent.; but the work performed has increased by 68 per cent. The average wage paid has fallen from £4 10s. 3d. per week to £4 3s. 8d. That is a drop of 7 per cent., but the cost of living index has fallen in the same period by 30 points.

THE electrification of the Wirral Railway—now part of the L.M.S. system—was one of the schemes undertaken with Government assistance under the Development Act. As was mentioned herein on June 13th, 1930, the work has not been commenced. The explanation for the delay is, it now appears, that it is hoped to run trains from the Wirral Peninsula into Liverpool over the Mersey Railway.

THE Irish railway companies have been seeking for a revision of pay and conditions of service. After discussion with the men's representatives a reduction of 4½ per cent. in the weekly paid staff and of 2½ per cent. in all salaries of £100 or less and of 4 per cent. in salaries over £100 was agreed to. At a delegate meeting on Tuesday, May 12th, the terms were rejected by the men by 47 votes to 42.

THE fifth fatal train accident of the present year and the third in which passengers have lost their lives occurred at Fakenham, on the Southern Area of the London and North-Eastern Railway, on Wednesday morning last. The line is single-tracked and a train from Wells and one from Dereham had to cross each other at Fakenham. The Wells train arrived first, and whilst it stood in the station it was, from some reason that is not at present clear, run into by the train from Dereham. One passenger was killed.

ACCORDING to Sir Josiah Stamp, the work done by the L.M.S. Advisory Committee on scientific research under Sir Harold Hartley is directed towards the problems of urgent practical importance, such as increasing the durability of the paint on carriages and the reduction of the wear of rails and tires. There was also a small joint committee which was investigating the question of locomotive water and fuel economy; this work dealing with water particularly promises to yield early results of considerable benefit to the company.

IN this column of our issue of April 10th reference was made to the Great Eastern Train Ferries Company, consequent upon the abandonment of the Channel Tunnel scheme, becoming interested in a proposed ferry based on Calais. It may therefore be noted that when the new steamer "Cote d'Azur" was put into service the chairman of the Southern Railway said that that company had recently been considering the possibility of running a ferry boat service for goods between England and France. It had been hoped that it might be possible to establish the service between Boulogne and one of the English ports, but that it had not been found possible to adopt that route, and "they might be forced to throw in their lot with other interests, making Calais the terminal on the English side."

IN explanation of the Great Western Company having spent 1½ millions on capital works last year, the chairman said at the recent annual meeting that, as the financial assistance which they were receiving from the Government for a period of fifteen years covered the major portion of the interest charges on the capital expenditure and as the whole of the works undertaken were desirable from the point of view of efficiency and should ultimately prove remunerative, the Board was satisfied that it would be to the mutual advantage of the proprietors and the railway's customers to carry out the improved facilities and modernisation of appliances upon which the expenditure was being incurred. The carrying out of the works during a period of depression not only assists trade and relieves unemployment, but minimises the expense and inconvenience which necessarily result from the dislocation when such works are in progress.

SINCE the Fenny Stratford level crossing disaster of December 6th, 1925, the Ministry of Transport has considered it necessary to inquire into five other cases in which passenger trains have run into road motor vehicles at level crossings of railways over roads—in five of these six cases they were public road crossings. On Saturday evening last there was a repetition of the Fenny Stratford case, when at Beddingham public road level crossing, 2½ miles on the Eastbourne side of Lewes Station, a motor car crashed into the left-hand gate of the two on the down side and fouled the down line just as the 9.40 p.m. express from Brighton to Hastings was approaching. All four occupants of the car were killed. Photographs of the disaster show that the gates were equipped with the requisite target and red lamp, and the measurements we have had taken show that there is 600 yards clear view of the gates and 300 yards of an approaching down train. The coroner's inquest was held yesterday—Thursday.

THE Board of Trade export tables for February show that the values of the railway material shipped overseas during the first two months of the present year was as follows, the corresponding figures for 1930 and 1929 being added in brackets:—Locomotives, £463,371 (£537,203, £464,292); rails, £111,714 (£489,885, £622,034); carriages, £411,508 (£292,556, £355,689); wagons, £219,871 (£497,978, £535,896); wheels and axles, £36,299 (£55,603, £74,209); tires and axles, £64,550 (£125,711, £95,741); chairs and metal sleepers, £20,654 (£124,282, £90,147); miscellaneous permanent way, £91,095 (£140,767, £193,879); total permanent way, £324,312 (£936,248, £1,076,010). The weight of the rails exported was 10,274 tons (53,291 tons, 72,277 tons), and of the chairs and metal sleepers 2092 tons (12,615 tons, 9239 tons). The value of the locomotives shipped during February last was £121,594, and included:—The Argentine, £58,569; India, £28,767. Other countries than the Argentine in South America, £14,672. The value of the rails shipped was £40,166, and included:—South Africa, £16,372; Portuguese East Africa, £14,180; the Argentine, £2024.

Notes and Memoranda.

IT is said that the manufacture of wireless apparatus in the United States consumes 110,000 tons of steel and 12,000 tons of copper annually.

AN oil can with a container made of rubber is being manufactured in South Africa. It is said to be practically unbreakable and is resistant to oil. The flow of the oil is regulated by the pressure of the hand.

THE new Burlington-Bristol bridge across the Delaware River, New Jersey, includes a lift span of 534ft., which can be raised from a height of 61ft. above water level to 135ft. in two minutes by two 80 H.P. electric motors.

AN indication of the rapidly decreasing cost of aerial travel is given in an announcement of Imperial Airways. The cost of going to Karachi, India, is £98 in money and 5 days in time, as compared with £104 and 17 days by land and sea. The fare to Kisumu, in Central Africa, is actually £2 less than that by first-class surface transport, and saves as much time as 23 days. These air fares are at least 10 per cent. below those of quite recent times and return fares show even greater reductions.

THE power plant of the Philip Carey Company, of Lockland, Ohio, which has just been started up, works at a steam pressure of 1840 lb. per square inch. There are two triple-expansion engines of 6060 H.P. each. They have twin single-acting high-pressure and intermediate-pressure cylinders, and one double-acting low-pressure cylinder. Exhaust at a pressure of 60 lb. is used for raising steam for process work. The water-tube boilers have forged drums 40in. in diameter and 5in. thick.

A MOTOR car parking machine has been devised, and put into practical use, by Mr. H. D. James, of the American Westinghouse Company. It comprises a vertical chain elevator with platforms large enough to accommodate a car. The car is left on the elevator during the time that it is parked, and the elevator is moved round by electric motors for the receipt or delivery of a car. In this way 24 cars can be parked on a ground space of 16ft. by 24ft., with a height of 105ft. Several elevators are arranged in one building and are operated by key-released push-button controls.

SOME striking developments have been made by the Babcock and Wilcox Company, at its Barberton, Ohio, works, in the welding of large-diameter heavy-wall pipe by the electric-resistance method. Using great pressure and very heavy currents, end-to-end joints have been made with 14in. seamless steel tubing having a wall thickness of 1 1/8 in. This heavy-wall large-diameter pipe is used by this company for headers in high-pressure superheaters and other boiler auxiliaries. By the electric-resistance method of welding standard mill lengths are joined to form sections up to 50ft. in length as needed in very large boiler units.

STATISTICS compiled by the Ashington Coal Company, Ltd., and quoted by the *Iron and Coal Trades Review*, show that 24,000,000 units of electricity, 50,000 gallons of oil, 250 tons of explosives, 140 tons of carbide and 2600 tons of pony food are used in its undertaking every year, and that there are in use 17,000 tubs, 600 wagons and carriages, 16 locomotives, 68 miles of underground haulage roads, 150 miles of 2ft. track for tubs below ground, and 95 miles of electric power cable. The number of separate pieces of timber used for roof supports per day is 19,000, and the number of steel props and girders 250 per day. During one year 97,000 tons of free coal are delivered to the workmen's houses.

IN collaboration with Sir Henry Lyons, Director of the Science Museum, South Kensington, the Gramophone Company, Ltd., Hayes, has developed in its research laboratories, an automatic electric gramophone which will describe in detail or give directions where to find any exhibit or exhibits in museums and similar places. The instrument can also be used to give brief lectures, six to seven minutes in length, on special exhibits. The first of these instruments has been installed in the Science Museum, where it is being used to give details of the exhibits on the top floor of the main building. Anyone wishing to hear about the contents of a show case or to receive directions as to where to find certain exhibits merely presses the button. Immediately the information has been given the instrument automatically switches off and returns to the starting position ready for the next inquirer. What a joy, says the *Electrical Times*, for the young idea on exhibition visits bent!

SOME experiments have been carried out at the Kaiser-Wilhelm-Institut, in Germany, on the strength of wire used in the manufacture of mining ropes. Steel wire with 0·6 per cent. carbon was heated in a laboratory patenting furnace at various temperatures from 810 deg. to 1070 deg. Cent., and then cooled in a number of different ways—in air, in lead baths at temperatures from 400 deg. to 600 deg. Cent., and in oil, followed by tempering. The test pieces were then reduced in area by 92 per cent. through eleven dies. The investigators point out that the bending tests specified in Germany for wire for mining ropes lead to preference for comparatively low furnace temperatures, while in Great Britain high-temperature furnaces are used to secure good torsion tests. They consequently suggest that fatigue bending tests would be more appropriate for judging the quality of such wire. Fatigue is best met by using comparatively high furnace temperature, low lead-bath temperature and moderate drawing (about 60 to 70 per cent. reduction). In practice it would, they think, be preferable to have the furnace too hot rather than too cold, since the latter lowers the fatigue limit to an exceptional extent. If higher tensile strength is necessary, it should be secured by a suitable increase in carbon, and not by too severe quenching or excessive reduction by drawing. They give a warning against the use of too high furnace temperature with too cold a lead bath in the case of high-carbon steels. Otherwise there is a danger that the wire will snap in pickling owing to high internal stresses. When high elastic limit is desired, for example, for springs, preference should be given to oil-hardened wire. Excessive drawing is not of much value; it is better to start with high tensile strength, *i.e.*, with higher carbon.

Miscellanea.

IT is announced that a flowing well of crude oil has been "brought in" near Burgos, in Spain. Another well in the asphalt district of Soria has begun to yield good oil.

THE Kirin Provincial Government of Manchuria proposes to construct a railway from Kirin, along the course of the Sungari River, to Tungkiang, on the Amur. The cost is estimated at about £2,500,000.

DURING March, 32,889 new motor vehicles were registered in Great Britain, as compared with 37,565 in March of 1930. The principal reduction was in motor cycles, while there was a slight advance in goods vehicles.

THE members of the American Zinc Institute have agreed to a levy of 50 cents a ton on slab zinc and 12½ cents a ton of concentrates to support research and educational work to improve the market for galvanised products.

A PARTY of British industrialists is leaving the country at the beginning of June to make a tour of German industries under the ægis of the Industrial Welfare Society, and will be personally conducted by Mr. R. R. Hyde, the director of the Society.

THE fifth span of the Bally Bridge, Calcutta, has been floated into place, and the sixth—last—span will be placed in July. These spans weigh 1700 tons, and have been floated out to the site on pontoons and lowered on to their seatings by the falling tide.

A PLAQUE to the memory of Sir Joseph Wilson Swan, the inventor of the incandescent electric lamp, is to be unveiled in the Sunderland Central Library, on June 5th, by Mr. C. C. Paterson, President of the Institution of Electrical Engineers. Sir Joseph was born in Sunderland.

A COMMITTEE has been appointed by the Board of Trade to consider the establishment of permanent accommodation for the London section of the British Industries Fair. This committee will not be concerned with the Birmingham section of the Fair, the accommodation for which is considered adequate.

IT is proposed to construct a fifth power plant on the Kootenay River, a tributary of the Columbia River in British Columbia. It is estimated that 30,000 horse-power can be developed at the new site, and when it has been completed the river will give over 200,000 horse-power within a course of only 20 miles.

THE new railway marshalling yards at Congella, Durban, have been equipped with a system of flood lighting. Had the old system of individual lights on poles been continued, it would have been necessary to have at least 300 poles dotted about the yard, but the new system requires only nine towers. They are 77ft. high.

ON Friday, May 22nd, revised overhead line regulations for securing safety of the public, were issued by the Electricity Commissioners. The new rules only differ, however, from those made by the Commissioners on April 16th, 1928, in respect of Regulations 5 and 18. Copies of the new regulations may be obtained from H.M. Stationery Office.

THE London Chamber of Commerce has been informed that the Patent Office Records in Nicaragua were entirely destroyed in the recent earthquake, and that a new office will be established as soon as possible. The authorities request persons holding registered trade marks or patents to send out their certificates so that particulars may be entered in a new Register.

THE Congress of the International Consultative Committee on the Technique of Radio Communications and of the International Radio-scientific Union opened in Copenhagen on May 27th. More than thirty countries are represented at the congress, which will continue until June 8th. The sittings are not open to the public. The British delegation is headed by Colonel A. G. Lee. The thirty United States representatives are headed by Mr. Wallace White, Member of the House of Representatives.

A CANNING factory, equipped with modern machinery and operated by electric power, has been established within a few hundred miles of the North Pole. It is operated entirely by Eskimos, mostly women. The factory, financed by the Danish Government, draws its power from the near-by rivers and is equipped with up-to-date dynamos and oil engines to cope with emergencies. It is situated in Holsenberg, Greenland, which has a population of about 250. A fleet of modern motor boats keeps the factory supplied with halibut, the principal catch of the vicinity.

THE Chinese Ministry of Industry is, according to the United States Commercial Attaché at Shanghai, negotiating with German interests for the erection of a steel plant in the Yangtze Valley, probably at Wuhu or some other place in Anhwei Province. This would involve the operation of coal and iron mines, the installation of a coke plant, and the construction of light railways connecting the mines with the steel plant. The capital for this undertaking is mentioned as the equivalent of 20,000,000 dollars, but considering the various projects involved, this amount does not appear to be sufficient. This plant should not be confused with the proposed steel works for Pukow, which are to serve for fabricating steel for railway purposes, and which, it is thought, will be financed by funds secured from the returned British Boxer indemnity.

ALTHOUGH letters patent for inventions and registrations of trade marks and designs granted in the United Kingdom do not extend to the Irish Free State, for which separate protection is required, many traders are said to be using the words "Patented" or "Registered" in connection with articles sent into the Free State and not actually patented or registered there, while others are also using the word "registered" in conjunction with trade marks without such trade marks having been registered there. Under the Irish Act—Industrial and Commercial Property (Protection) Act—it is an offence punishable with fine to represent as patented an article which is not patented in the Irish Free State. It is understood, in fact, that the Irish Free State Controller of Patents is actually contemplating commencing proceedings in many cases. The same remarks apply to trade marks.

LARGE BREAKDOWN CRANE

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(*For description see page 604.*)

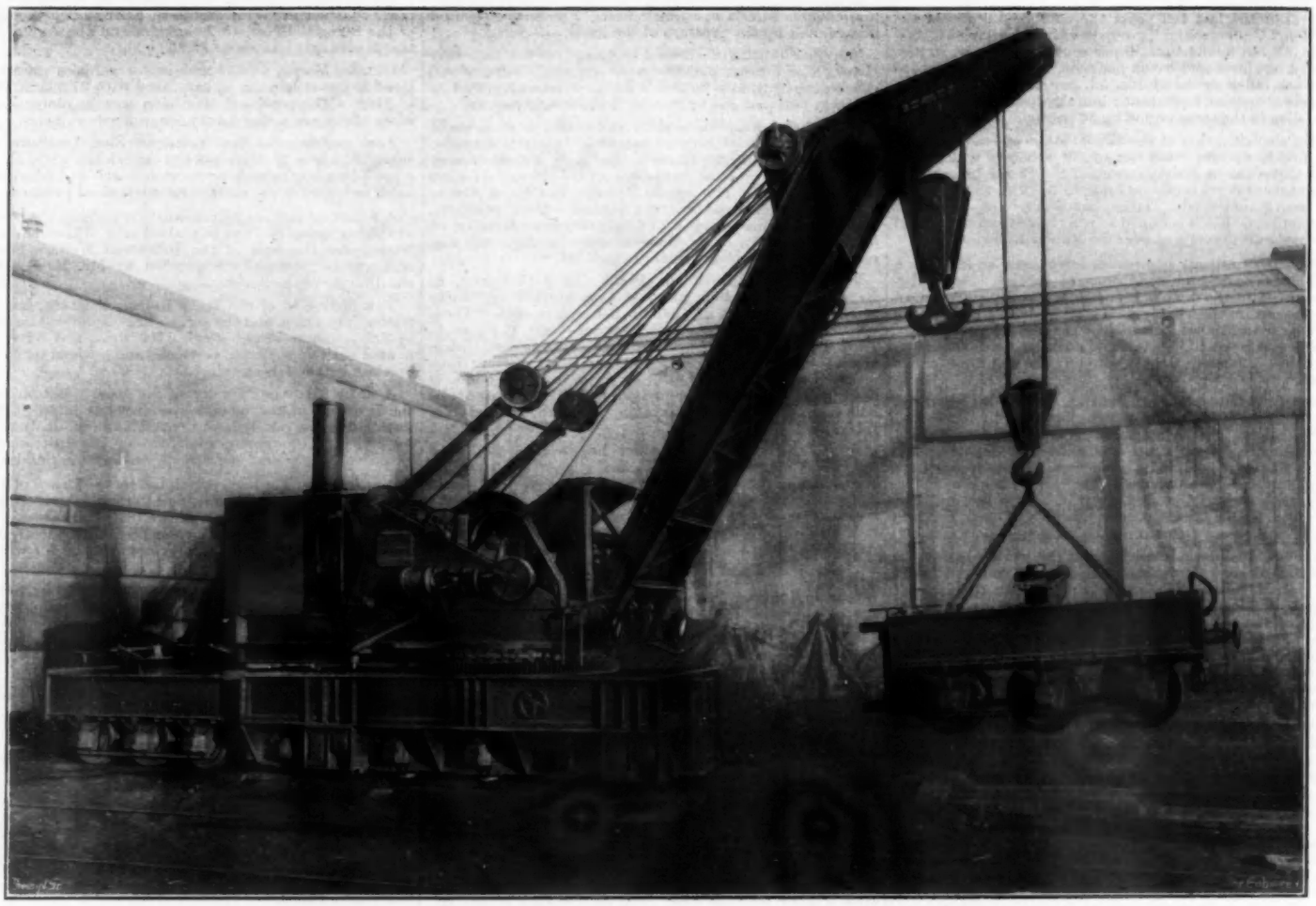

FIG. 1—CRANE HANDLING ITS BOGIE IN PREPARATION FOR WORKING

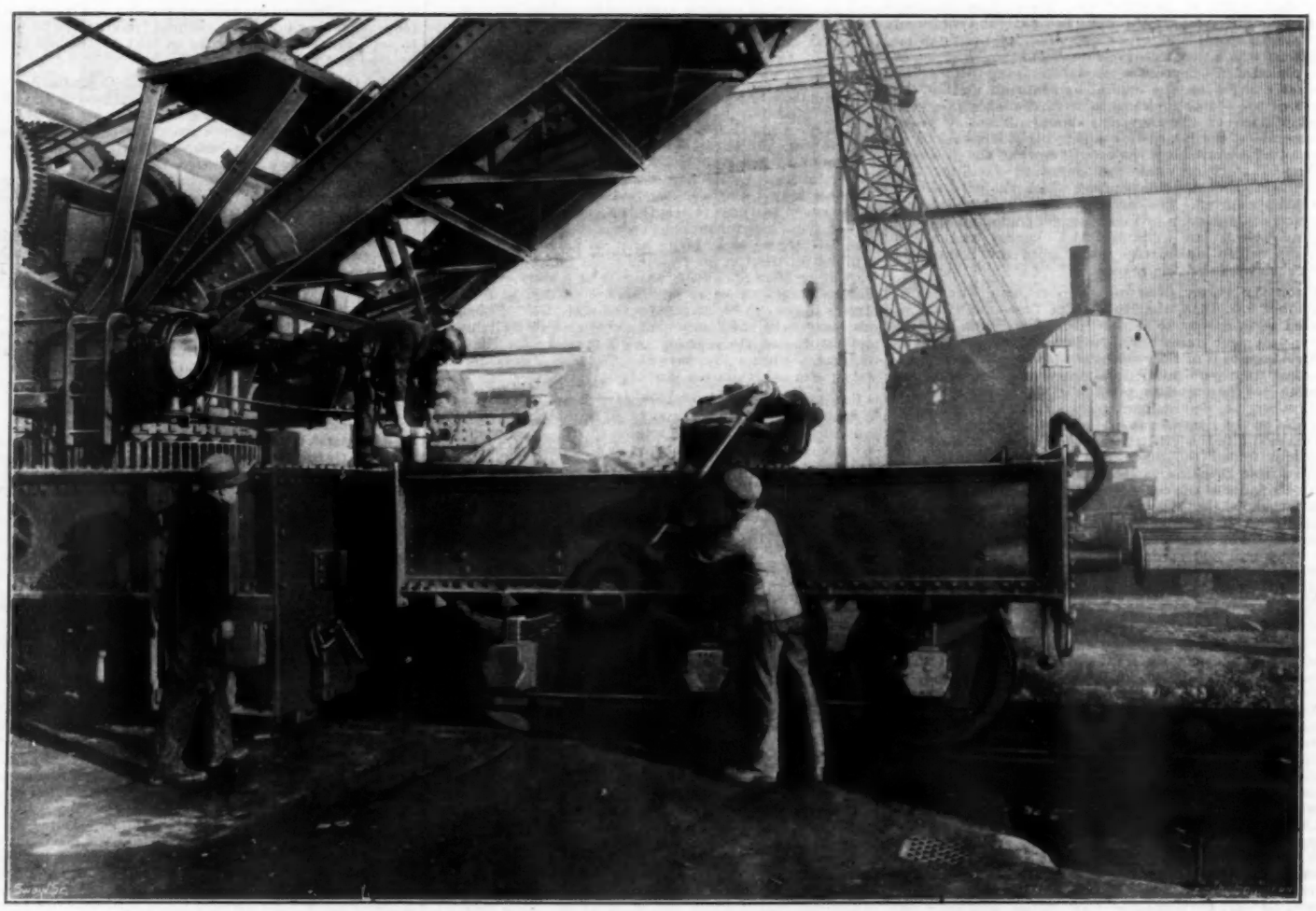

FIG. 2—COUPLING A BOGIE IN PREPARATION FOR TRAVELLING IN A TRAIN

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The Metallurgist.

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THE ENGINEER.

VOL. CLI No. 3933

MAY 29, 1931.

Science and Industry.

THE successful pursuit of trade requires that attention should be paid to three main factors. They are—first, Economic and Industrial Conditions. Under this heading are included all matters relating to wages and hours of labour; to the taxation and rating of industries; to labour regulations by Government; to the means and cost of transport; to banking, tariffs, and similar affairs. Secondly, Marketing, which covers such subjects as salesmanship; publicity and propaganda; deferred payments; accommodation to the needs of the market; packing, and kindred matter. The third is Technical and Scientific Progress. This heading includes new designs and inventions; the discovery and utilisation of new materials; and generally the application of the advances, and discoveries of science to useful purposes. Unless attention is paid to all three of these factors, trade development comes to a standstill. If the industrial and economic conditions are disadvantageous, if costs of production are too high because the hours of labour are too short or the wages per piece excessive, if governmental regulations and taxes lay too heavy a burden on factories, means of transport and public services, then the competitive capacity of the manufacturer is impaired. If salesmanship is lukewarm and inefficient, if the needs of the market are not met, if there is carelessness about essential conditions, then, even though the first factor were satisfactory in all respects, trade could not flourish. Finally, unless there is an unresting activity in the application of science to industry, neither perfect industrial and economic conditions nor all the skill of salesmanship can prevent the decline of competitive trade. The formula for Trade is $T = A \times B \times C$, and as it is impossible to say that any one of the three factors is greater or less than another, the omission of a single one reduces the result from a cubic value to a square value.

There are some grounds for thinking that one of these three essential factors is receiving less attention than it merits. In times of industrial stress, like that now prevailing, there is a tendency to concentrate upon the two factors first named, because the results to be anticipated are more obvious and more rapid. Hence, we have had several reports by authoritative bodies upon Economic and Industrial Conditions, amongst which we may mention that by the Balfour Committee—see THE ENGINEER, March 15th, 1929—"Realities and Problems," issued by the Engineering and Allied Employers' National Federation—see THE ENGINEER, December 5th, 1930—"The Industrial Situation," issued by the National Confederation of Employers' Organisations—see THE ENGINEER, February 13th, 1931—"Wages and Working Conditions," being a report of the proceedings at a special conference between the Engineering and Allied Employers' National Federation and Various Trade Unions on January 30th, 1931; and various memoranda by the Federation of British Industries. On Salesmanship and Marketing, we have not only the able reports of Sir Francis Goodenough's Committee, numerous reports by the Department of Overseas Trade upon the markets of the world, but stirring advice from the Prince of Wales and others who have devoted personal study to the subject. But when we turn from the first two factors to the third, we are struck by a remarkable contrast. To the best of our knowledge, there is not in existence a single report drawn up by a qualified committee upon the application of science to industry. The public is largely and frequently advised upon labour and financial problems, it hears a great deal concerning salesmanship and marketing, but it is badly instructed as to the industrial value of science. This neglect of the third factor leads it to believe that trade can be restored if only attention is given to the problems of the market-place, to the reduction of industrial taxation, or to fiscal changes. It is not told with the same insistence that unless science is continually applied to useful purposes the other factors will be without avail. Something, indeed, is said from time to time about the equipment of British factories. It is usually ill-informed on the facts and ignorant about the conditions. The public knows more about what is being done in America or Germany than of the achievements of its own country, and jumps to the erroneous conclusion that what can be done in those lands can be done in Great Britain. But outside these technological matters, which are easily and effectively used for propaganda, its ideas on the applications of science in industry are meagre indeed. It has heard of the Department of Scientific and Industrial Research, and is aware that in the delightful surroundings of Teddington there is a place called the National Physical Laboratory. It knows also that physicists and ultra-physicists do wonderful things with atoms, ions, electrons, and particles with Greek epithets, and it takes a dilettante interest in the origin and constitution of the universe around us. But on the fundamental importance of science to industry it knows far less than it does about the value of Spanish to merchants in South America, or the need of watertight packing cases for the Straits Settlements. Even industrialists themselves are not wholly free from criticism in this respect. It is well known that the formation of Industrial Research Associations has often been faced by severe obstacles, and that the financial support given to them is too often inadequate. Again, the learned societies are from time to time urged to give more attention to industrial questions, as if there were not already too little time for the discussion of the scientific problems which form their proper field of endeavour. We have endless shows and exhibitions directed to the purpose of selling goods, and but a single one in the whole year devoted to science, and it is not by any means free from the touch of trade. Even the technical and scientific newspapers have to face continual pressure to rob space which should be given to scientific subjects, for the benefit of trade.

All these things are indicative of the fact that the *general feeling* with regard to the important part played by science in industry and trade is not what it ought to be. Whether or not much could be achieved, as some seem to think, by the employment of men of science as administrators or Members of Parliament; by the increase of their influence in the Civil Services; or by the augmentation of their salaries in municipal posts, may be open to a measure of doubt. But there is no doubt at all that, in all classes—for the indus-

trialists themselves form no exception—greater knowledge of and therefore greater sympathy with the fundamental part which science plays in industry would be beneficial. Something more is needed than the drawing-room atmosphere of the British Association. The position of Science in respect of Trade needs to be as clearly shown as that of Labour or Salesmanship. Whilst the country is courting the two, not wholly unprepossessing, sisters, it is neglecting Cinderella. She also merits a report, and we are glad to know from the speech which Sir Samuel Hoare recently delivered as President of the British Science Guild that a champion for her has been found. The Guild intends to undertake an investigation of the potentialities of existing industries and the effect that the proper application of science would have upon them. "What inquiry," asked Sir Samuel, "could be more useful at the present moment?" What indeed! We have had more than enough reports on the first two of our three postulated factors; they are beginning to repeat themselves. It is full time that attention was paid to the third, and we are confident that if the intention of the British Science Guild receives the support which it merits we shall in due course see a memorandum which will place Science in its proper relative position to Industrial Questions and the Problems of Marketing.

Accidents to Railway Servants.

When two men, with the opposing interests of employer and employed, are brought together to discuss questions as to which they differ, a good step has been taken towards the settlement of the points that need adjustment. If, added to these two, there is a third, who, whilst neither master nor man, has a responsibility for seeing that certain things, provided they be reasonable, are done by the employers for their servants, the discussions are yet more likely to attain their object. Finally, if, for the purpose of order and co-ordination in those conversations, there is a practical person—again neither a representative of the masters nor of the men—to act as secretary, an ideal conference for the adjustment of complaints is attained. That is the constitution of the Railway Employment Safety Appliances Committee, which has just celebrated the twenty-fifth anniversary of its appointment. We must, however, go fifteen or twenty years further back to learn the origin of the purpose of the Committee. In 1886 a Private Member's Bill was brought in for the compulsory provision of automatic couplings and other safety equipment on railways. The dissolution of that year stopped its progress, but in 1889 when Sir Michael Hicks-Beach was seeking powers to compel the railway companies to adopt the block system, interlocking, automatic continuous brakes on passenger trains, &c., an attempt was made to include automatic couplings. The opposition of the proprietors of privately owned wagons was, however, so great that, in order to obtain the powers sought, as to which there was no objection, the clause as to couplings was dropped. Exactly ten years later Mr. Ritchie made another effort, but, from the same cause, he failed, and the Royal Commission on Accidents to Railway Servants was thereupon appointed—thirty-two years ago to-morrow, May 30th—"to inquire into the causes of accidents, fatal and non-fatal, to servants of railway companies and truck owners."

Whilst the main purpose of the present article is to show the good work done by the above-named Railway Employment Safety Appliances Committee, it seems desirable that, first, we should see what followed upon the report of the Royal Commission. That body said that it had come to the conclusion that the number of accidents amongst railway servants was unnecessarily great, and could, by means of authoritative action, be diminished. It was, however, felt that grave responsibility rested upon those who had to determine upon the remedies that should be applied to effect the desired result. It was observed that the saving of life and the avoidance of injury were difficult to weigh in comparison with other considerations, and some regard must be had to the general interests of the country. The Commission thought, however, that the Legislature ought to invest the Board of Trade with certain powers for the inspection and regulation of the work done by shunters, goods guards, brakesmen and platelayers. Procedure was to be by the drafting of regulations dealing with each danger as it presented itself, and by the repeal or alteration of such regulations from time to time, so as to fit the circumstances of each class of case. Among the twelve subjects on which the Commission considered that regulations should be made were:—The covering-in of point rodding and signal wires, so that men did not trip over them; the better lighting of shunting yards; point levers to be parallel with and not at right angles to the line; wagons to have labels and brakes on both sides; boiler gauge glasses to be so constructed or protected as not, when breaking, to be a danger to the men; gauges showing the amount of water in the tender, and tool-boxes on locomotives to be so placed that there should be no need for enginemen to climb over the coal when running. The sequel to this report was the Railway Employment (Prevention of Accidents) Act, 1900, which authorised the Board of Trade—since 1919 the Ministry of Transport—to make rules as to dangerous occupations. Such rules may require the use of any plant or appliance which has been shown to the satisfaction of the Board of Trade to be calculated to reduce danger to persons employed on a railway or the disuse of any plant or appliance which has been similarly shown to involve such danger. Public notice was to be given of any proposed rule, and if any objection thereto did not secure withdrawal or amendment by the Board of Trade, the objector could call upon the Board to refer the proposed rule to the Railway and Canal Commission, whose duty, and only duty, was to say whether or not the proposed rule was reasonable. As showing the spirit in which the railway companies received this legislation, it may be observed that the Act was passed on July 30th, 1900, and the draft of the first ten rules was issued on April 27th, 1901. One rule was objected to, and the objection sustained by the Railway and Canal Commission on July 29th, 1902, but the other nine were accepted, and came into force on August 8th, 1902. In passing, it may be said that the disputed rule is the only one with which the Railway and Canal Commission has been troubled. The Royal Commission, although its appointment was obviously the result of the demand for automatic couplings, made no definite recommendation thereon. The report observed that "their successful use in America did not necessarily establish that such couplings can be adapted to the wagons in use in this country," and so it advised that practical experiments should be conducted, and that the Board of Trade should be empowered to appoint a Departmental Committee to co-operate with the railway companies when such experiments were made.

The Campbell-Bannerman Government came into power in December, 1905, and Mr. Lloyd George was made the President of the Board of Trade. Questions addressed to him showed that the Departmental Committee just referred to had not been appointed. But, on April 28th, 1906, just twenty-five years ago, the Railway Employment Safety Appliances Committee was set up. It had three members—a representative from the companies, one from the men, and the Chief Inspecting Officer of Railways. The secretary was—and is still—Mr. J. P. Scott Main, now the Assistant to the Chief Inspecting Officer. The only change in the Committee, beyond those due to death or retirement, is that Mr. Main has, since 1928, been a member additionally to being secretary. The Committee, on its appointment, was faced with two major problems. One was the rule that had been successfully resisted by the companies. That rule related to brakes on both sides of wagons, and after the Committee had inspected fifty-one models and sixty-nine full-sized brakes, the present either-side brake rule was issued on November 7th, 1911. The other unsolved problem was that of automatic couplers. That question was brought to a sudden standstill by a masterly memorandum, dated August 8th, 1907, to the Board of Trade by Sir Arthur Yorke, the Chairman of the Committee, wherein he asked four questions, of which three, briefly, were:—How is the enormous expenditure of the change to automatic couplings to be met? How are the proprietors of privately owned wagons to be dealt with? How are the dislocation of traffic and risk of accidents to men and trains during the experimental and transition stages to be faced? Sir Arthur added that until those questions had been considered and answered, it would be inexpedient and useless to initiate a series of long and costly experiments. The Committee, which, it must be remembered, included the representative of the men, said it entirely agreed with the remarks contained in the memorandum. It thought, however, that some improvement could be effected in the method of coupling three-link stock, but, a year or so later, it reported that therein it had been disappointed.

In other directions, however, very fine work has been done by the Committee. Perhaps its chief influence has been among permanent way men. Its amendments in the rules concerning them have been the main cause in reducing the risk of a platelayer being killed from one in every 550 employed to one in every 993. There have also been great improvements in minor matters, which have diminished the number of non-fatal cases. The good effect of these is seen in the fact that whereas in 1913 one man in every 112 employed on the railway was hurt, the proportion now is one in 198. As to the fatal cases, it should be recorded that in 1901 one in every 1173 servants lost their lives by accident; to-day the risk is one in every 3021. It is only fair that on the twenty-fifth anniversary of its appointment, the Railway Employment Safety Appliances Committee should be congratulated upon the way in which it has conducted its work and the success it has attained.

Literature.

Business Leadership. Edited by Henry C. Metcalf, Ph.D. Sir Isaac Pitman and Sons, Ltd., London. 1931. 10s. 6d. net.

It is a somewhat arresting statement that "the common man has little to do with progress except to hold it back," and it only makes the reader anxious to ascertain what are considered to be those qualities that single out a man from his fellows as one fitted to assume a position of leadership. In the book under review the subject is investigated from different standpoints, for its twenty-five chapters are from the pens of no less than twenty-two authors, the whole being skilfully edited by Dr. Henry C. Metcalf, who so arranges the views of engineer, university professor, philosopher, psychologist, and industrialist that a definite sequence is presented, and a conception of the broad principles of successful business leadership is reached, even if there appears to be no finality in the research.

At the outset it is as well to realise that this work is the product of Americans, the instances taken as illustrations are chiefly from life in the States, and some of the expressions are unusual. For example, instead of "functionalization" we should probably say "functional organisation," and although grasping the meaning we should hardly express the opinion that "leaders cannot be called leaders because of an arbitrary hunch." All might possibly agree that it is not wise "casually to bawl a man out" before his fellow-workmen. Having accustomed himself to differences in phraseology, the reader will be able to enjoy the vigorous and crisp style of the contributors.

The different phases of leadership in the past are cursorily sketched, and the argument propounded that if the then civilisation produced military leaders, a business society should in time evolve business leaders, following which the question is raised as to whether the success of a leader is due to heredity or to a systematic training. While we might not be prepared to go to the length of agreeing that "the organic tendency of man to produce natural economic and civilised leaders for an economic, scientific type of society is inherent in his hereditary constitution," we find in succeeding chapters that other contributors take a much broader view and realise that heredity is only one of many factors contributing to the production of a true leader. Similarly, our criticisms are frequently answered further on in the book itself, so that the conclusions reached by us, if in disagreement with one writer, may be in full accord with the general consensus of opinion of all the contributors.

While we cannot hope to touch on all the aspects considered, there are some ideas which are of great value in bringing about that even balance that is so essential to an organisation. The relation between the business leader and the expert is often badly defined, so that the latter tends to degenerate into one who gives advice, which essentially implies a "take it or leave it" attitude, whereas in his particular sphere the expert should be leader. There must be genuine "relatedness," with each leader aspiring to what is termed an "integrative unity."

It may be true that "potential leaders will not be discovered until workable methods of appraising leadership are evolved," but at the same time, as we visualise all the card indexing, with the difficulties incident to the correct measurement of such qualities as tact, degree of originality, output of energy, and self-control, we cannot help feeling that there is still something to be said for the rough-and-ready methods which have hitherto obtained.

The desirability of fostering the spirit of leadership cannot be too strongly emphasised, and as responsibility builds strength, so this trait should be developed in the minor executive, and real attention given to the growth of the employee, so that in effect managers and workers grow up together, and leadership is developed through management sharing.

It is refreshing to see that a British factory is selected as a typical case of instilling ideas of common purpose in the mind of the employee, and we are told that in the factory at York, "when a group of new girls is taken into this factory, . . . Mr. Rowntree, the president, gives a talk to these girls. He tells

them what their work is all about; he shows them how one person being careless in dipping chocolates may make the young man, who takes a box of chocolates to his best girl on Saturday night, say that he won't get Rowntree's chocolates next time." By enlarging on this theme, girls are shown "that common purpose rather than Mr. Rowntree himself is their leader."

In looking round for the most fertile source from which to obtain leaders, Dr. Overstreet advocates the engineer type of leadership. "Potentially speaking, your engineers certainly are the most available candidates for service in industry. Veblin . . . has revealed their strategic position in industry if they only knew it. But they do not." This is rather a sweeping statement, for we can certainly call to mind numbers of engineers who have risen to leadership, even at the expense of traditional opposition.

The vexed question of the degree to which a college course fits the graduate for leadership is carefully investigated, and while we agree as to its value, we are of opinion that industry must prove to be the real training ground. We cannot cavil at the writer's conclusion, for after saying "in bringing this discussion to an inconclusive end," he pleads for further study on a subject of far-reaching importance.

As we draw to the close of this fascinating book, or perhaps it would be more correct to allude to it as a series of papers, our opinion becomes crystalised, we brush aside with contempt those false prophets who preach that there is no sympathy in industry, and instinctively agree that "the best leader has not followers, but men and women working with him," and that there must be constructive relationship between workers and management; moreover, we are prepared to subscribe to the final dictum of the philosopher who regards the true leader as the "intercreative co-ordinator."

If we are to conclude in a philosophical vein, we might perhaps consider the thoughts of a man who boasts that he is not an industrialist, but a plain man and a philosopher. After agreeing that ideal leadership involves "power-with" rather than "power-over," he throws out the suggestion that perchance the logical sequel should be "income-with" rather than "income-over." Here is food for thought.

We have only been able lightly to skim the surface of a most interesting study, the depth of which can be appreciated by the reader if he attempts the task of answering the very provocative questions which appear at the end of most chapters. This exercise should prove interesting and instructive. Unfortunately, the selected references to books and papers germane to the subject are almost exclusively to American publications, and it is suggested that this section might with advantage be extended in future editions.

The High-speed Internal Combustion Engine. By H. R. RICARDO, F.R.S. London: Blackie and Son. Price 30s.

IT is a serious misfortune that the men best qualified to write upon engineering subjects so often lack the time, or the inclination, or both, to commit their experience to paper. Mr. Ricardo is a happy exception. He, at any rate, has conquered the disinclination, and made the time, to give us a book which no one who is responsible for the design of internal combustion engines can afford to be without. We say advisedly that he has conquered a disinclination, for we suspect that in book-writing Mr. Ricardo does not feel so much at home as he does in a laboratory or in a drawing-office. His book is not very well arranged, and it is only his natural clarity of thought, combined with a complete mastery of his subject, that saves it from being somewhat bewildering to the reader. It is a book for the practising engineer rather than for the student, and in it the designer and engineer will find guidance on almost every important aspect of the engine, and guidance, moreover, which is based on first-hand experience, critically sifted by a master hand.

The chief differences from the earlier edition of the book are the addition of an extra chapter on the high-speed Diesel engine, a line of development in which Mr. Ricardo has led the way, and also short additional sections dealing with the results of recent research work.

We have one complaint to make. When the domain of the engineer borders upon that of the physicist, then it is the duty of the former to be meticulous about his use of words, and to see that the terms he uses agree with the sense in which the physicist or the chemist uses them. On page 21 Mr. Ricardo writes: "The heat value of the 'correct' mixture is usually termed the total 'internal energy' of the working fluid. . . ." Now, the internal energy of a gas is an exactly defined concept in the domain of the physicist, which by accepted usage is taken as zero at N.T.P. Mr. Ricardo's statement is quite inconsistent with this. If any departure for practical purposes is made from the accepted use, then the special sense in which the term is used should be clearly explained, and reasons given. Again, in referring to his formula for the efficiency of an engine based on air consumption, namely—

$$E = \frac{\text{I.H.P.}}{\text{pounds of air per hour}} \times C$$

Mr. Ricardo says: "C is a constant representing the amount of heat liberated by the combination of 1 lb. of air; for all petrols, it may be taken as 196." To this the chemist may very properly object that the heat liberated by 1 lb. of air cannot be a constant for different fuel-air mixtures, and that it is certainly not equal to 196 in any units whatever. The fact that in practice the number of pounds of air consumed per H.P. hour has been found to be roughly constant over a wide range of mixture strengths, on which fact the formula is based, is in reality due to a more or less fortuitous balance of circumstances. What the symbol C really represents is $\frac{33{,}000 \times 60}{778}$, divided by the heat liberated by the combination of 1 lb. of air under the conditions of the experiment.

There are other points on which Mr. Ricardo's wording cannot fail to be confusing to those who approach the matter for the first time. Thus on page 21 he says that "in the case of volatile liquid fuels . . . the power output available is, therefore, entirely independent of the calorific value of the fuel," and a few lines earlier he insists that "it cannot be too strongly emphasised that the heat value of a volatile liquid fuel bears no relation whatever to the power output obtainable from that fuel." Those familiar with the subject will know what he means, but Mr. Ricardo is not writing only for the initiated, and, after all, one may object to the above phraseology, that if the fuel had no calorific value there would, at any rate, have been no power output!

We must end this review, however, on a note of gratitude, not of criticism, for these grounds of complaint are comparatively trifling by the side of the great service which Mr. Ricardo has done to British engineering by making public the results of his experience.

It is a pity that several misprints in the first edition should still persist in the second edition, eight years later.

Autobiography of an Engineer. By WILLIAM LE ROY EMMET, Sc.D. New York: Fort Orange. 2 dollars.

THE author of this book is not so well known in this country as in America, but his researches and experiments with regard to the mercury vapour turbine have aroused very considerable interest here, for it is to him that the chief credit for the development of that form of prime mover is due. His experiments with the turbine began as long ago as 1913, and it must be a very great satisfaction to him now after nearly twenty years of work to see an installation working with success at the South Meadow station of the Hartford Electric Light Company, and to know that a new and larger set has recently been ordered.

Apart from the interest that must always be aroused by the history of the life, thoughts, and actions of a man who has had a hand in bringing about much of the development of engineering practice in the present century, the book will be read with delight and, we think, with a certain amount of astonishment in this country on account of the light it sheds upon the American character in general. To English ears the author appears at every stage of the book as an approving critic of his own actions, his own character, and his own vigorous decision. But when a few chapters have been read it becomes apparent that this is not vanity or a desire to make himself out to his readers as a better or greater man than he is. The presumption is forced upon the English reader that an American would find nothing unusual in the way that the book has been written.

In a discussion of his own character at the beginning of the book, the author remarks that he believes that he inherited absentmindedness from his mother, but his illustration of the lengths to which this defect led him leaves us in some doubt as to whether that statement should be taken seriously. To arrive at the first tee of a golf course without any trousers must, we think, create a record!

In a later chapter, when he is telling us of his experiences at the Naval Academy—his original intention was to join the Navy—he has much of interest to say about education. He is himself an illustration of the fact that comparative failure in studies and classes does not prove ineptitude for activities in later life. His position throughout the time of his education in the Academy appears always to have been low, and he had considerable difficulty in attaining the required standard. Owing to alterations in the method by which men were accepted into the service from the Academy, which coincided with the period at which he left it, he did not join the Navy.

After the early struggles at the very bottom of the ladder about which he tells us without forgetting to mention his dissatisfaction with his jobs and his belief that he was capable of much better things, he became associated with the Sprague Company, and from that point onwards the book deals largely with his engineering activities.

Later he tells us of his work for the General Electric Company, and we read of his attempts, finally crowned by success, to get the turbo-electric method of ship propulsion adopted by the Navy. Finally, a sketch of his doings in connection with the mercury vapour turbine is presented.

We are introduced throughout to numbers of men, most of whom perhaps are better known on the other side of the Atlantic than here. Some, however, among whom Edison must be included, have also European reputations.

When a few "Americanisms" are allowed for, the book is well written and can be recommended for its intrinsic interest, besides the excellent picture it conveys of the American outlook and character. The author sets forth his own actions, his criticisms of other people's actions and his belief in his own methods. Once the reader has got used to the sound of Mr. Emmet's own trumpet, he will find that there is much of interest and value in the book.

SHORT NOTICES.

The Chemical Technology of Steam-raising Plant. By Henry Norman Bassett. London: Edward Arnold and Co. 12s. 6d.—With the coming of higher steam pressures, the desire for greater and greater efficiencies, the use of pulverised fuel and oil, and the multiplication of parts in the boiler, many new problems have been presented to the boiler-house engineer. Higher temperatures and pressures have had an effect upon metals employed and higher rates of evaporation have made the question of the purity of the boiler water more important than ever. As a result the chemist is being called upon more often to study problems affecting the management of boiler-rooms. Although the author of this book is of the opinion that the ideal superintendent of a boiler plant would be a chemist with engineering experience, he admits that such an ideal is hardly likely to be obtainable for some years to come. Under the circumstances, he believes that a book on the chemical side of the subject will be found useful by many engineers. The book treats of the water supply, its softening and filtration, &c.; scaling and corrosion of the boilers and auxiliaries; fuels and their combustion, and the significance of the composition of the flue gases. There are chapters on indicators and recording instruments, boiler testing, furnace linings, and boiler laggings, and, finally, on materials of construction.

The Elementary Theory of the Internal Combustion Engine. by F. W. Ludlam, B.Sc. London: Blackie and Son. 3s. 6d.—This little book is intended for the use of engineering apprentices and others wishing to study the theory of internal combustion engines. Such students are frequently none too well equipped mathematically, and in consequence the author explains as fully as possible in words the operations he performs later mathematically. To ensure that the student has gained a clear idea of the work included, examples are added at the end of each chapter. The subjects treated are the laws of gases, the Otto and Diesel cycles, and the actual performance of internal combustion engines.

SIXTY YEARS AGO.

THE disaster which befell H.M.S. "Captain" in September, 1870, led men's minds to a renewed study of the conditions governing the stability of ships at sea. The impetus was received not before it was required. If a correspondent, S. Barrass, who wrote in our issue of June 2nd, 1871, can be accepted as a trustworthy guide to current naval architectural theory and practice, contemporary knowledge concerning the safety and stability of ships at sea would appear to have justified his description of it as a discredit to our scientific ingenuity. According to Mr. Barrass, our naval architects, inside and outside the Admiralty, had got into a rut. Chiefly, they erred in their belief that the stability of a ship in still water provided an indisputable criterion whereby to judge the safety of the ship when at sea, and exposed to the rolling action of waves. They tested their vessels in a dock and measured the rate at which the amplitude of oscillation died away. Such a test was held to determine the dynamical stability of a ship. Mr. Barrass had the truth before him, although it is clear that he found some difficulty in expressing it. The naval architect's measure of stability was, he insisted, a statical one, and provided no clue to the real dynamical stability, the capacity of the ship to resist the upsetting forces applied to her by a train of waves. He went so far as to argue that the still water stability of the naval architect was a factor promoting the instability of a ship in a seaway. It required a Froude to work out the general equation for the unresisted rolling of a ship among waves, but our correspondent obviously had in his mind the factors which Froude subsequently embodied in mathematical language. Even at the moment, Froude, Scott Russell, Macquorn Rankine and others were busy laying the foundation of our modern knowledge concerning the structure of waves, the manner in which they cause a vessel to roll and the qualities which a ship should possess in order that she may resist their capsizing action. In the same issue in which Mr. Barrass wrote we reported very briefly a lecture on sea waves delivered by Rankine before the Royal Institution. The views which he expressed are still accepted, but it is curious to note how much attention he devoted to a point in the theory of ship stability, which, while well founded, is of comparative unimportance as affecting the question of a ship's safety at sea. Rankine gave much of his time to a discussion of the manner in which the period of a ship, like that of a pendulum, increases with the angle of oscillation. In ordinary vessels with tumble-home sides, the period, he said, would increase as the rolling became more violent. Hence, if the period of the ship and the waves were initially equal, the dangers arising from isochronism would be eluded by the subsequent increase in the period of the ship. The truth is that the increase of the period with increase in the rolling angle is in general too small to make much difference to the safety of the ship, or becomes sufficiently great to make a difference only when the angle of roll has reached the limit from which the ship can recover.

LARGE BREAKDOWN CRANES

RANSOMES AND RAPIER, LTD., IPSWICH, ENGINEERS

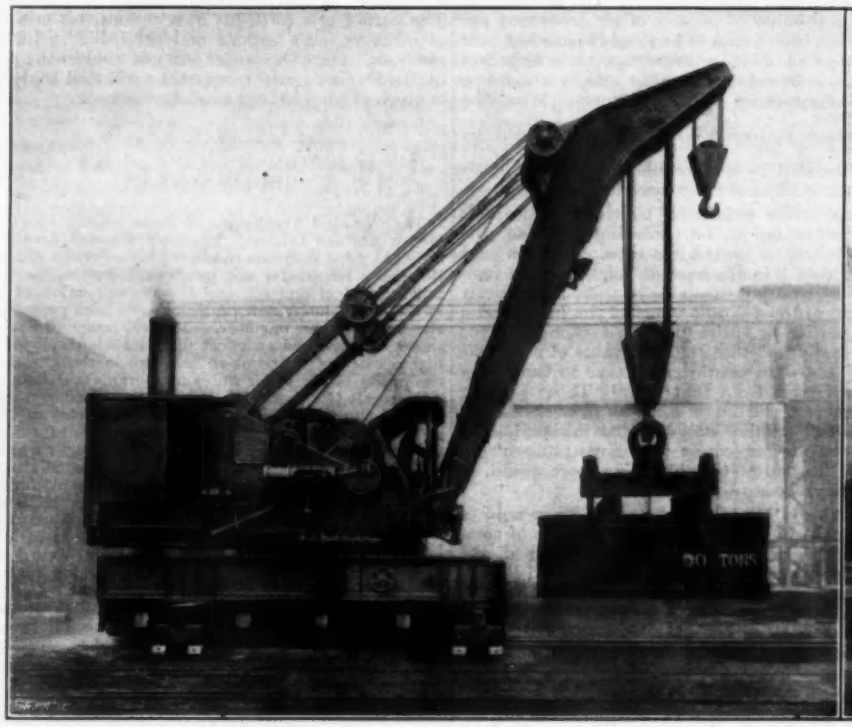


FIG. 3—105-TON CRANE OPERATING WITH PART OF COUNTERWEIGHT

FIG. 4—75-TON CRANE

Large Breakdown Cranes.

ALTHOUGH breakdown cranes of considerable size have been constructed in Great Britain for home, colonial, and foreign railways, their lifting capacities or duties have been restricted by various factors, such as the low permissible axle loading when in train order, the limit of loading per foot run over buffers, the width of embankments and cuttings, the limited distance to which the propping girders can be extended, and the small width and height of the loading gauge. Nevertheless we illustrate in Figs. 1 and 2 on page 600, and in Figs. 3, 5 and 6, a crane which, in spite of these restrictions, is of exceptional power; in fact, it is the heaviest duty breakdown crane built in Great Britain, and is remarkable in that the travelling axle load is only 17 tons, the load per foot run over the buffers 2·93 tons, and the propping base is restricted to 17ft.

The crane, which is of the Stokes relieving bogie type, was manufactured by Ransomes and Rapier, Ltd., of Ipswich, for his Majesty's Government, and has been satisfactorily tested with a load of 126 tons at a radius of 20ft. Without the special relieving bogies, which weigh 11 tons each, the weight of the crane in working order is 160 tons. When arranged for travelling in a train—see Fig. 6—part of the weight of the jib is carried by a match truck, which weighs 9 tons, and 11 tons of the counterbalance is detachable. When in train order the total weight is therefore 180 tons, producing a load of 2·36 tons per foot over the buffers for the whole crane set, and for the crane and bogies only 2·93 tons. In every detail the crane has been specially designed to comply with the requirements of the engineers at the War Office, and the makers' latest improvements relating to the mechanical and structural features, and their improved patented Stokes relieving bogies have been embodied in the construction. Four cranes of similar design—see Fig. 4—have recently been manufactured to Sir John Wolfe Barry and Partners' specifications by Ransomes and Rapier for the Bengal-Nagpur Railway, for the main purpose of bridge erection. Although designed for a slightly smaller duty than that of the War Office crane, at the time they were built these cranes were for a larger duty than that of any crane built in this country, and were tested satisfactorily with a load of 93¾ tons at 21ft. radius.

During the past sixty years Ransomes and Rapier have devoted special attention to railway equipment, and to-day the firm is in a position to manufacture breakdown cranes of the greatest capacity permitted by the travelling conditions. By way of comparison, it is interesting to consider the large and powerful breakdown cranes illustrated and the heavy locomotives they can deal with, in relation to the first locomotive introduced into China, built at the firm's Ipswich works in 1874. The locomotive was named the "Pioneer," and although it only weighed 26 cwt., it could haul an appreciable load at 15 to 20 miles per hour.

The most powerful breakdown cranes are built in America, where exceptionally heavy locomotives have to be handled. Some of them have a lifting capacity of over 200 tons, but this great capacity is only rendered possible by the fact that the axle loading and other factors are not so restricted as they are in other countries, a loading of upwards of 30 tons per axle being permissible.

In the cranes under consideration the Stokes principle was adopted because of the short and compact undercarriage that can be employed, and the large clearance obtainable when lifting bulky loads over either end, as compared with that obtainable with an ordinary crane having a long undercarriage. If the Stokes principle had not been adopted, the War Office crane would have required an eight-axled carriage and the Bengal-Nagpur crane a six-axled carriage, necessitating undercarriages of such a length that the clearance when working over the headstocks would have been so small at the front end as to be useless for the primary functions for which the cranes are intended. Moreover, there would have been no clearance at all at the rear end of the carriage, for with ordinary types of breakdown cranes that have the jib resting over a truck when in train order, the top part has to be placed nearer to the front end of the carriage to enable equal loading of the axles to be obtained within the prescribed limits.

The originator of relieving bogie breakdown cranes was the late Sir Wilfrid Stokes, chairman and managing director of Ransomes and Rapier, Ltd., who have been the sole makers of this useful railway appliance. Some improvements in the design of the Stokes bogies have recently been patented by the company to enable them to be as easily attached or detached on a curve as when on a straight track, the coupling arrangements being such—see Figs. 7 and 8—that the operation of attaching and detaching the bogies can be carried out in a few seconds. The operation of preparing the War Office crane for travelling in a train, involving the process of transferring the load to the bogies, detaching part of the counterweight and resting the jib and snatch-blocks on the match truck, can be performed in 10 minutes, whilst the reverse operation of transferring from "train" to working order takes about 6 minutes. The bogie springs are calibrated and are provided with indicators to enable an operator with but limited experience to prepare the crane for "train" order.

For the benefit of those who are not fully conversant with this particular type of crane, it may be advisable to give a brief description, and to set forth the advantages claimed for it. The main object of the Stokes crane is temporarily to increase the wheel base and to reduce the concentration of the axle loading when in train order by the addition of a bogie at each end of the crane carriage. In this way the weight is distributed over a long flexible wheel base when travelling in a train, but over a short wheel base with a consequent very short carriage when the crane is in operation, thereby enabling the crane to approach its work easily. When the bogies are attached, as indicated in Fig. 6, part of the weight of the crane is transferred to the bogies by means of relieving girders, operated by a worm wheel and screw gear. When the crane arrives near the wreck or at the destination where other work has to be performed, the bogies are detached and handled by the crane, as shown in Fig. 1 on page 600, and are placed clear of the working area, whilst when the crane is ready for its homeward journey the bogies are hoisted back and re-attached to the crane. If necessary the crane can deposit its bogies some distance from the wreck and travel to, or return from its working area under its own steam. Coupling and buffing gear of the railway's standard type is required only at the outer end of each bogie, but the crane carriage can be fitted with buffer beams and draw hooks—see Fig 7—to enable it to perform yard and shunting work without its bogies. The relieving girders are so arranged that the bogies can pivot on them in all planes. The girders can also move radially about their own fixing pins, and the bogies can take up any angular position, both laterally and longitudinally, thereby

FIG. 5—CRANE OPERATING WITH FULL COUNTERWEIGHT

providing a completely flexible wheel base for the whole crane set.

With ordinary types of heavy breakdown cranes, if the top part is placed centrally between the headstocks to give equal clearance when lifting over either end, and if even loading of the axles is to be obtained, the jib has to be suspended on the derrick ropes, or only a portion of its weight may rest on the match truck when travelling in a train, for otherwise the centre of gravity would move so far back as to give much greater load on the rear axles, and this load would exceed the railway limit. The advantages claimed for the Stokes crane can therefore be summarised as follows:—(*a*) It can have its top part midway between the headstocks with the crane axles evenly loaded in train order, whilst the jib rests upon the match truck. (*b*) It can travel with its match truck at either end, so that it is always the right way on for its work, and does not need to be reversed by a turntable, whilst there are

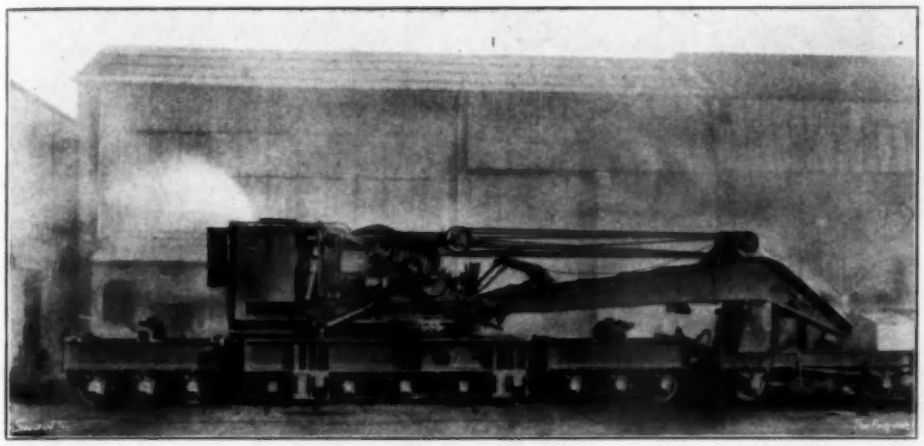


FIG. 6—CRANE READY FOR TRAVELLING IN A TRAIN

equal and large clearances at each end. (*c*) As the match truck is short, it can readily be handled; and (*d*) even for the heaviest duty crane, only two sets of propping girders are necessary. The crane is particularly suitable for bridge erection, and if necessary it can operate when engaged on work of this kind with its bogies attached, thus maintaining the very low axle loading, which is a special feature of the crane. It can also travel under its own steam with or without its bogies, and with its jib in a raised or lowered position to clear bridges, &c. In view of the special requirements with regard to clearances when lifting parallel to the track, it was not possible to place the top part of the large War Office crane illustrated midway between the headstocks. In this particular case, the clearance is 9ft. 6in. over the front headstock and 5ft. over the rear.

The duties for which this crane was designed are as follows, each motion being tested with loads 20 per cent. above the working loads given* :—

Lift and Slew a Complete Revolution with Propping Girders.

Main hoist—
- 105 tons at 20ft. radius with full ballast
- 65 tons at 25ft. " " "
- 45 tons at 30ft. " " "
- 90 tons at 20ft. with portion of ballast detached
- 60 tons at 25ft. " " "
- 40 tons at 30ft. " " "

Auxiliary Hoist—
- 25 tons at 35ft. " " "

Under the above conditions the jib and ropes have a factor of safety of six, and other parts not less than five to one.

To Operate in all Motions on a Level Track or Grade of 1 in 50 Without Propping Girders.

Main hoist	20 tons at 20ft. radius
Auxiliary hoist	15 tons at 25ft. "
Auxiliary hoist	12 tons at 30ft. "
Auxiliary hoist	8 tons at 35ft. "

Owing to the great duty for such a small axle load and propping base, the makers had to arrange for an additional counterweight to be added when the crane is operating at its maximum capacity, but this can easily be handled by the crane itself with the special tackle supplied, which is similar to the arrangement employed on many large cranes previously manufactured for the English railways. The distinctive appearance of the crane, and more particularly that of the derricking jib, which is of the plated type, is well shown by the illustrations. The crane is driven by a 400 horse-power engine fitted with Stephenson link motion reversing gear, with two cylinders, each 11in. diameter and with a stroke of 12in. The Cochran-Hopwood multitubular boiler, which works at a pressure of 150 lb. per square inch, was manufactured by Cochran and Co., Ltd., of Annan. It is 5ft. 6in. in diameter and 8ft. 6in. high, and lagged with asbestos and planished steel sheets. An auxiliary hoist gear is fitted and the snatch blocks are so arranged that a large clearance is always available between the main and auxiliary blocks, even at the minimum radius. The snatch blocks can lower 16ft. below rail level at 20ft. radius, and when in the highest position the hooks are 24ft. and 28ft. above the rail level respectively. The auxiliary hoist was tested with a load of 30 tons. The travel motion is fitted with change gear, giving a maximum speed of 75ft. per minute on a gradient of 1 in 50 and a maximum of 5 miles per hour on a straight and level track. The hoisting speed for 105 tons is 10ft. per minute and for 50 tons 20ft. per minute. When lifting 20 tons the speed of the auxiliary hoist is 55ft. per minute. As regards slewing, the tests showed that one complete revolution could be made in three minutes with full load, whilst the derricking speed was 6ft. per minute, all these speeds being obtained with the engine running at the normal number of revolutions.

For the purpose of obtaining creeping speeds under full command of the driver without relying on the foot brake, which can, however, also be used if desired, a new device has been introduced into the driving mechanism in the form of an oil resistance pump, which is connected with the engine crank disc. On test it was found possible with this new system of control to obtain a creeping speed of ¾in. per minute when the crane was lowering a load of 105 tons, the adjustment of the load called for on this particular crane being ⅛in. when lowering and ¾in. when slewing. Another noteworthy feature of the crane is that the driver can obtain an exceptionally good view of the load for, as, shown in Fig. 3, all the controls are situated in the fore part of the superstructure. A canopy which can be lowered as shown in Fig. 6, when the crane is to travel in a train and which is fitted with removable side curtains, is placed over the driver's position when the crane is in operation, and a fixed canopy is also arranged over the boiler and firing platform. An electric floodlight equipment consisting of a 550-watt turbo-generator set made by Stone and Co., Ltd., of Deptford, supplies current to 150-watt "Tonum" floodlights on the jib and on either side of the revolving top, and also serves for lighting the cab, whilst for the purpose of plugging in portable floodlights for use when the crane is slewing loads collector gear is fitted to the centre pin for the supply of current to four sockets.

The crane sides, which consist of double steel plates, are firmly mounted together with the gear, &c., upon a heavy cast steel foundation, thus giving a very stiff and solid framework, whilst the arrangement also eliminates deflection and imperfect alignment, which are liable to occur when wrought steel cross girders are fitted between the side frames for the pathways and centre pin. The top turns on a live ring of rollers, which are arranged so that any roller can be removed without disturbing the superstructure. The heavy thrust of the jib is not applied to the side steel plates, as this practice is likely to cause distortion, and the thrust is therefore applied directly to the

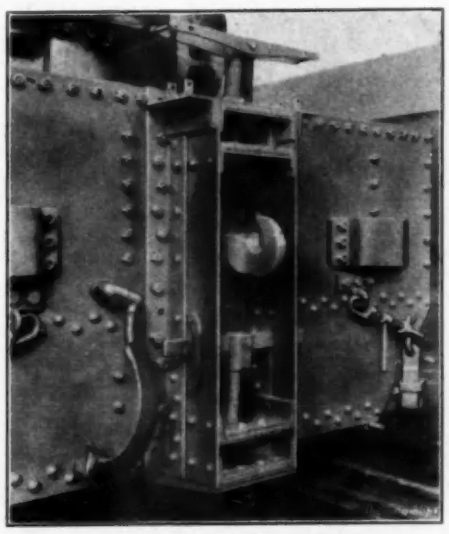


FIG. 7—DRAW HOOK IN END HEADSTOCK AND COUPLING PINS

cast steel bed-plate. The gear is so arranged that any shaft can easily be dismantled for inspection or repairs, and the bearings are of the adjustable type. To all the motions efficient brakes are fitted, whilst the carriage is provided with a hand screw brake for three axles which is operated from either side of the carriage. This hand brake is combined with a steam brake, which can be operated from the driver's cab and can take full command of the crane when it is working on gradients without its propping girders; it is also arranged for control by hand from the driver's position when the crane is not under steam. Through piping with swan necks and couplings is also fitted for use with the Westinghouse brake when the crane is travelling in a train. The undercarriage is designed on sound lines and consists of two massive girders of the box type, which are rigidly connected together with heavy headstocks and diaphragms, whilst the propping girder boxes are of the continuous plate type.

The two sets of telescopic propping girders are each fitted with a special distributing beam and two jacks, thus giving an even bed and good distribution of the heavy jack load. With this type of carriage, the loading is definite and the stresses are correctly and easily determined, whilst deflection is minimised and rigidity is promoted. Cranes fitted with three sets of propping girders involve difficulties in calculating the loads on the prop screw jacks, owing to uneven and varying soil at the place of the wreck. It is quite possible for the end jacks to be resting on hard ground and the centre jack on soft ground, with the result that when slewing, the centre jack might sink owing to incorrect packing and cause such extreme stresses in the undercarriage that the elastic limit of the material may be reached. With cranes having a centre prop a much greater load comes on the prop screw than is the case with those having two end props. Owing to the fact that the majority of engineers favour the telescopic prop, this type is arranged for and is fitted with special ratchet gear, which enables each propping girder to be housed or extended into position in a few seconds by one man. As the load is taken directly into the box girder side frames, thus avoiding the tendency to twist of the hinged arrangement, the telescopic type of propping girder is preferable. Girders of this description are placed in position as quickly as, if not more so, than a hinged prop. They can be used in a variety of positions to meet specific requirements, and they are secure and stiff laterally. If a hinged prop is made adjustable to suit a varying base, the prop screw takes a circular path, which would not be suitable for bridge setting purposes or for work in a confined area. With the hinged arrangement the carriage side frames usually have to be of the single-web type, thus rendering the side girders more liable to distortion after a considerable amount of heavy usage.

The cast steel axle-boxes, springs, and suspensions conform with the best locomotive practice, and are all arranged on the outside of the horn plates, where they are easily accessible. Screws are fitted over each axle-box to relieve

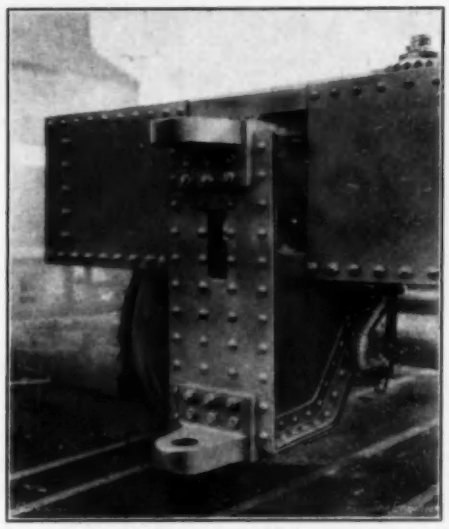


FIG. 8—BOGIE RELIEVING GIRDER SHOWING THE SPECIALLY-SHAPED COUPLINGS

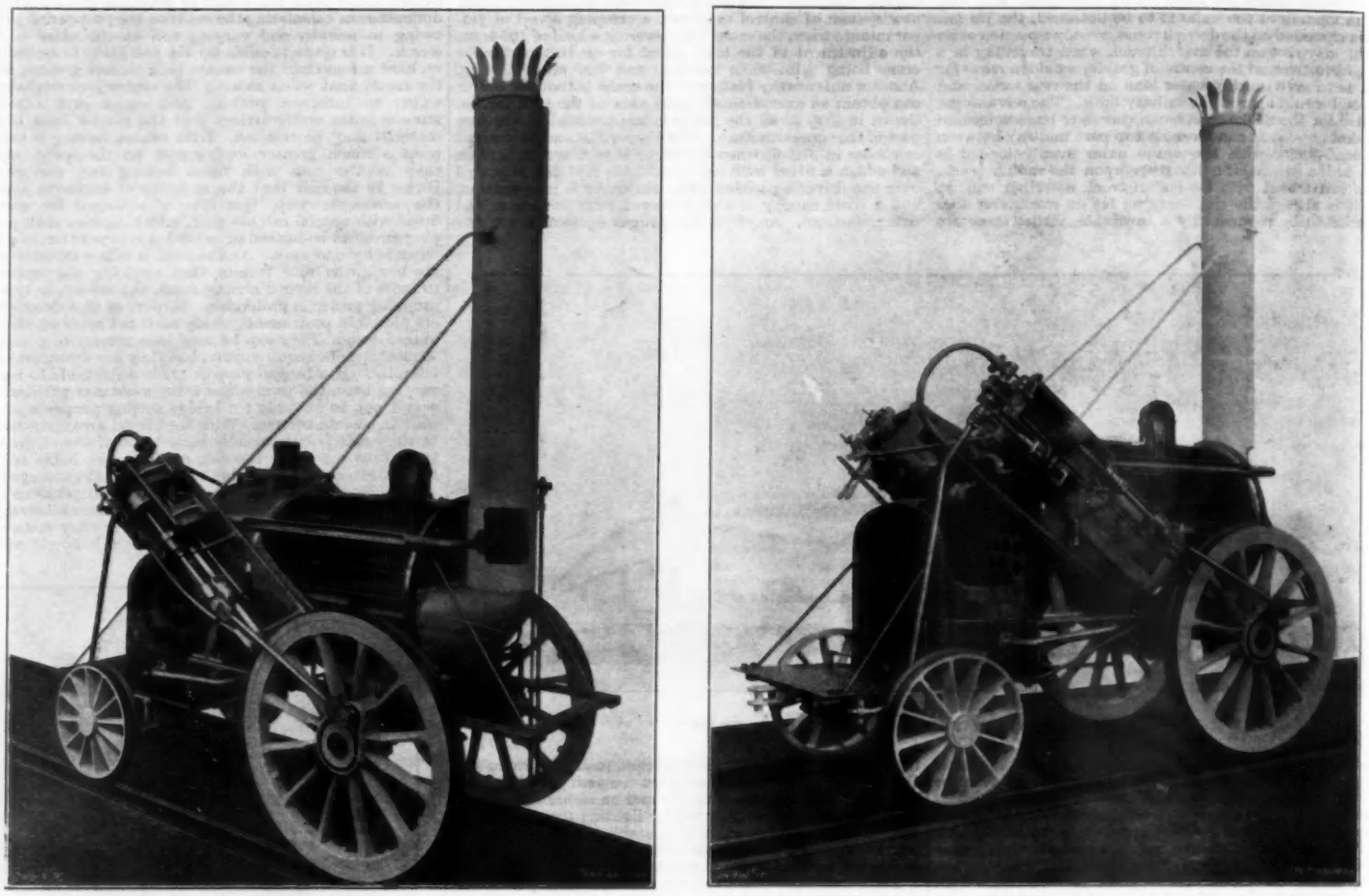
the springs when the crane is in operation. All the gears are composed of steel, and with the exception of the slewing rack and pinion and the travel spur gear fitted to the axles—which has the makers' special form of tooth to promote easy clutching after travelling in a train—all the gears are machine cut. With a view to reducing the weight to a minimum without impairing safety, the shafts and pins are made from high-tensile steel; all bearing brackets and pulleys are also composed of steel. To enable the crane to slew in either direction without reversing the engines a special friction clutch is fitted to the slewing gear. We are told that under test, when handling the 126-ton test load, the crane was remarkably rigid and the ease of control under all conditions exceeded expectations.

The illustration Fig. 3 shows the War Office crane lifting and slewing a 90-ton load through a complete revolution at 20ft. radius without the additional counterweight, whilst Fig. 5 shows the crane performing the same operation with a 126-ton load with all the counterweight in use. Fig. 6 shows the crane ready for travelling in a train with the jib resting on the match truck; Figs. 7 and 8 the improved patented interlocking coupling arrangement and the draw hook fitted in the headstock for shunting work when the bogies are detached. The 75-ton crane shown in Fig. 4 is, as we have said, one of four cranes made for the Bengal-Nagpur Railway with a revolving top mounted centrally to give equal clearances at either end. The crane can travel in a train with the match truck fore or aft, and it does not need reversing on a turntable. The two views of the War Office crane, Figs. 1 and 2, on page 600, show the crane handling a bogie in preparation for working, and the operation of coupling a bogie and relieving the crane of part of its weight so that the crane may travel in a train.

THE new rail and structural steel mill of the Algoma Steel Corporation at Sault Ste. Marie, Ontario, now engaged in rolling 130 lb. rails for the Canadian Pacific Railway, is operated entirely by electricity. The 5000 H.P. mill motor installed in the plant is said to be the largest D.C. machine ever built in the Dominion, and also the largest industrial motor drive to be installed in Canada. The motor is capable of developing a maximum operating torque of 1,180,000 lb.-ft., and a maximum emergency torque of 1,450,000 lb.-ft. Hydro-electric power is received from the Great Lakes Power Company at 11,000 volts, stepped down to 6600 volts at an outdoor transformer station.

* All tons 2240 lb.

SECTIONALISED REPLICA OF THE ROCKET



The Rocket.

We feel sure that our readers will find interest in the two illustrations of the "Rocket" which we give above. It will be recalled that some months ago a full-scale replica of the famous Rainhill engine was built by Robert Stephenson and Co., Ltd., of Darlington, for Mr. Henry Ford's museum. It was as like the original as possible and was actuated by its own steam. The present replica is similar, save that, as will be seen from our pictures, it has been in part sectionalised. Its home is the New York Museum of Science and Industry, formerly the Museum of the Peaceful Arts. We hear, with pleasure, that yet another complete replica has been ordered, this time for the Julius Rosenwald Museum of Science and Industry in Chicago. It will be suitably mounted and can, if desired, be operated through its own engine by compressed air stored in the boiler at a few pounds pressure.

So far America has placed all the orders for these copies of one of the most famous locomotives in the whole world, but we shall not be surprised to hear that another country, nearer home, wishing to make its historical collection complete, has one built. We venture to express regret that there is no sign of one being purchased for this country. True, we have the original in South Kensington, but not in the form that it had at Rainhill, and it does seem a pity that the money cannot be found to purchase one either for the Railway Museum at York or for South Kensington. We should like to see a complete series of replicas right up to the "Planet" which embodied every principle of the steam locomotive except the link motion.

Present Position of the Iron and Steel Industry.*

The Executive Committee of the National Federation of Iron and Steel Manufacturers had under consideration at its meeting on May 21st, the memorandum of the Iron and Steel Trades Confederation, relating to the present position of the iron and steel industry, and its suggestions as to the steps which might be taken to deal with that position.

The Committee is in agreement with much of the statement of the Confederation as to the position of the industry, and the employers, as represented by the National Federation, have repeatedly brought many of these views to the notice of successive Governments during the past ten years.

The Federation is gratified to find such a large measure of support for its views in the memorandum of the Confederation. In view of the form of organisation indicated by the Confederation, it is desirable to repeat that regional organisation, based on amalgamation of similar interests, which was initiated by the industry itself, has already made substantial progress in every district.

It can surely hardly be a matter for surprise that greater effect has not been given to this policy under the conditions under which the industry in this country has been labouring since the war; particularly when such movements towards amalgamation are governed and limited by the effects of unparallelled depression instead of being stimulated by the legitimate expectation of prosperity.

The principal conclusion in this memorandum to which the Federation finds itself definitely opposed is the suggestion that State control in any form could possibly assist the industry in the solution of its present difficulties. In the view of the Federation any form of organisation partaking of the nature of nationalisation, must inevitably destroy the competitive power of the industry in world markets, and thus involve it in complete economic collapse, rendering its continued existence only possible by subsidy from the taxpayer.

Productive industry is working under conditions entirely different from those which obtain in the monopolies controlled by public utility corporations; productive industry is in world competition, and in the judgment of this Federation this can only be effectively met by an industry organised on the principles of private enterprise.

The Federation contemplates that such units of organisation will ultimately attain regional dimensions with a co-ordinating body to formulate and direct national policy, in, for example, such matters as development, marketing and international negotiations. But, in its considered view, this is only possible with a protected home market as appears to be recognised by the Confederation.

This is the only country in the world with an unprotected home market. It must be borne in mind that the industry has been handicapped to an extent that is neither fully recognised nor appreciated by its expansion during the war period to meet national needs. This is the only country with the exception of the United States—where the need did not arise—in which the capital expenditure incurred for national purposes was not entirely written off from national funds.

In addition, continental competitors liquidated their capital debts as a result of the policy of inflation of their currency, and further received compensation from national funds, for losses incurred as a result of the war, which enabled them to rebuild their industries, on the basis of the most modern knowledge and practice without incurring a proportionate permanent capital charge in respect of that expenditure. Given the conditions under which British industrial enterprise can justifiably increase its capital expenditure, the Federation is confident that the British iron and steel industry will be able to increase substantially its competitive power, and once more provide profitable employment for its proportion of the industrial population of this country.

The Federation has invariably agreed, and, in fact, proposed, that, in the event of the home market being protected, consumers' interests should be safeguarded by the setting up of a board, judicial in character, to which any representative body of consumers could appeal in the event of the effect of a tariff creating conditions under which their interests were adversely affected.

The Federation agrees with the dictum of the Confederation that:

> "No Government, whatever its political complexion, can justifiably ignore conditions which bear upon the welfare and stability of a great basic industry";

but would remark that every post-war Government has ignored these conditions except in the case of the belated de-rating provisions of the last Local Government Act.

The British iron and steel industry is actively developing its forward policy of organisation, productively, commercially, internationally and Imperially, but is handicapped by present conditions. If, however, unemployment is not to increase a national industrial policy must be adopted, including the relief of industry from the present excessive burdens of taxation, protection of the home market, as a basis for international co-operation by the industry itself in securing the stabilisation of world prices and market conditions by international agreement; the use of tariffs as a means of negotiation for obtaining entry to markets now barred by tariffs as the only effective means of securing a greater measure of freedom in world trade which all sections of the community desire.

* Memorandum issued by the National Federation of Iron and Steel Manufacturers.

3000-Volt Traction Rectifiers.

The electrification programme now in hand by the Delaware, Lackawanna and Western Railway covers approximately 68 route miles and 158 track miles of line in the suburban district west of Hoboken, and includes the main passenger line from Hoboken to Dover, *vid* Newark, the Oranges, Summit, and Morristown, and the branch lines to Montclair and Gladstone. The 3000-volt D.C. system is used with power delivered to trains by means of an overhead contact system fed from five sub-stations owned and operated by the railway and erected along the right of way. For converting 60-cycle A.C. into 3000-volt D.C., mercury arc rectifiers are employed exclusively, and, according to the American *General Electric Review*, from which the following notes are taken, they were chosen, in preference to motor generators, because of their relatively low first cost, high efficiency, and their ability to carry heavy overloads without injury. Other advantages offered by these rectifiers were small floor space and simple foundations.

The sub-station buildings housing four 3000-kW rectifier tanks are only 64ft. long by 40ft. wide, with an average height of 27ft., and are small in comparison with the buildings which would be required to house motor generator sets. The rectifiers were purchased under a specification requiring a guarantee of successful operation in service under loads of 150 per cent. of current rating—50 per cent. overload—for two hours, and 300 per cent. current rating—200 per cent. overload—for five minutes. During the acceptance tests, short-time overloads up to 600 per cent. of the current rating—500 per cent. overload—were applied and were successfully carried for periods of 10 seconds.

The rectifier tanks are equipped with the usual anodes, vacuum pumps and gauges. The tanks are water-cooled, by a closed cooling system with forced circulation under thermostat control. The circulating water for each rectifier tank is re-cooled in a cooler unit, somewhat similar to an enlarged motor car radiator, using a circulating pump and motor-driven fan. Heating elements under thermostatic control are also provided to prevent the various parts of the rectifier becoming too cool when shut down or lightly loaded. D.C. smoothing reactors to reduce the ripple in

the D.C. voltage, and resonant shunts to deal with high-frequency harmonics which would cause interference on communication circuits, are also provided. The resonant shunts are tuned for 360, 720, 1080, and 1440 cycles. Surge suppressors made up of capacitors with limiting resistances are provided to protect the transformer secondary windings and the interphase transformer windings against the high-voltage surges induced when the residual current flow following an arc back or internal short circuit is interrupted by the arc being extinguished. The shell of the rectifier tank and some of the associated equipment is at substantially cathode potential—3000 volts above earth—when the rectifier is in operation. This equipment is therefore insulated from earth and carefully protected from accidental contact while in operation. In addition to the overload protection provided by the oil circuit breaker on the A.C. side of the transformer, each rectifier unit is protected by a high-speed circuit breaker of the magnetic blow-out type on the positive and negative side.

The outstanding features of the rectifiers, apart from the voltage and capacity of the units, are the anode grid excitation arrangements and the automatic compounding. A cross section of a rectifier tank is shown in Fig. 1, where one of the main anodes, which are made of graphite, is to be seen on the left. In addition to the usual shields and baffles provided to shield the anodes from the mercury thrown up from the cathode mercury pool by the arc stream, each anode is also surrounded by an inner shield suspended from a porcelain insulator. This shield supports a mesh grid, made of special high melting point metal, mounted just below the face of the anode. The inner shield and grid, which are insulated both from the anode and the tank case, are connected by a separate bushing, passing through the anode seal and through a resistor to an excitation circuit, the opposite pole of which is connected to the cathode. Voltage applied to the grid ionises the mercury vapour near the face of the anode, and thus assists in establishing the power arc. This permits much closer shielding of the anodes than would be possible without the grid excitation, and consequently reduces the tendency for the rectifier to "arc back" or short circuit internally from anode to anode, and also materially reduces the amount of power necessary in the "holding" anode circuit. Tests have been made both with D.C. grid excitation with a grid voltage of 96 volts—above cathode potential—and with twelve-phase A.C. excitation with the grid voltage leading the anode voltage by 12 deg. to 15 deg. The shielding of the rectifier is so complete that it will not establish the power arc and pick up load until the grids are excited, whilst if the grid excitation is cut off while a rectifier is carrying load the rectifier immediately drops its load.

The rectifier compounding circuit is shown diagrammatically in Fig. 2, where the main power circuits are indicated by the heavy lines and the auxiliary compounding circuits by the lighter lines. The twelve-phase secondary of the main transformer is made up of four three-phase secondaries with their neutrals connected together through interphase transformer windings. From the standpoint of the external circuit the four three-phase windings make up a true twelve-phase secondary, each having a phase displacement of 30 deg. from the next. Owing to the action of the interphase transformers, however, when the rectifier is running non-compounded, each of the three-phase windings operates as a separate three-phase unit, and the voltage on the D.C. side of the rectifier is the voltage corresponding to a three-phase rectifier. The shifting of the arc from anode to anode in the three-phase units results in triple frequency or third harmonic voltages, which are impressed on the third harmonic interphase transformers.

The compounding is accomplished by shunting the third harmonic interphase transformers—which connect neutral N_1 with N_2 and N_3 with N_4—by means of two compounding circuits, each containing a capacitor and a winding of a compounding reactor. The D.C. windings of the compounding reactors are connected in series with the main power circuit, and consequently the saturation of the cores of the compounding reactors is varied with the output of the rectifier. Obviously, as the saturation of the core varies the reactance of the compounding circuit and its admittance to the third harmonic voltage across the third harmonic interphase transformer winding also vary. The compounding circuits may therefore be tuned so that the capacity and reactance balance at the core saturation corresponding to the D.C. load at which the maximum compounding effect is desired. At that point the reactance of the compounding circuit to the third harmonic voltage is substantially zero and the third harmonic interphase winding is therefore substantially short circuited so far as the third harmonic current is concerned. The two three-phase windings then function as a six-phase winding, and the rectifier D.C. voltage corresponds to the voltage of a six-phase rectifier. In other words, at very light loads the D.C. voltage corresponds substantially to the voltage of a three-phase rectifier, and as load comes on, owing to the shunting of the third harmonic current from the interphase transformer winding through the compounding circuit, the condition approaches more and more nearly that of the six-phase rectifier, and the voltage is varied accordingly. The two compounding circuits are linked together by means of the balancing reactor to insure balancing the load between the two groups of anodes. The compounding circuit can be adjusted to hold the D.C. voltage substantially constant up to 225 per cent. of rated load with relatively little increase in voltage at intermediate loads. The compounding of the rectifier is adjusted to give approximately 3000 volts up to substantially 150 per cent. load, using a total of 416 kVA of capacitors in the compounding circuits of each 3000-kW rectifier unit.

The power factor of the compounded rectifier unit, including the transformer, is notably high, showing approximately 96½ per cent. lagging at 25 per cent. load and increasing with load to 99 per cent. lagging at 50 per cent. load, slightly leading at 150 per cent. load, and back to 99 per cent. lagging at 300 per cent. load. The effect of compounding capacitors on the power factor is greatly increased, owing to the fact that they are in circuits carrying third harmonic frequency. When compounded rectifiers are operated in parallel, it is necessary to provide an equalising bar above the compounding reactor in order to ensure an equal compounding effect and equal division of load between the rectifier units.

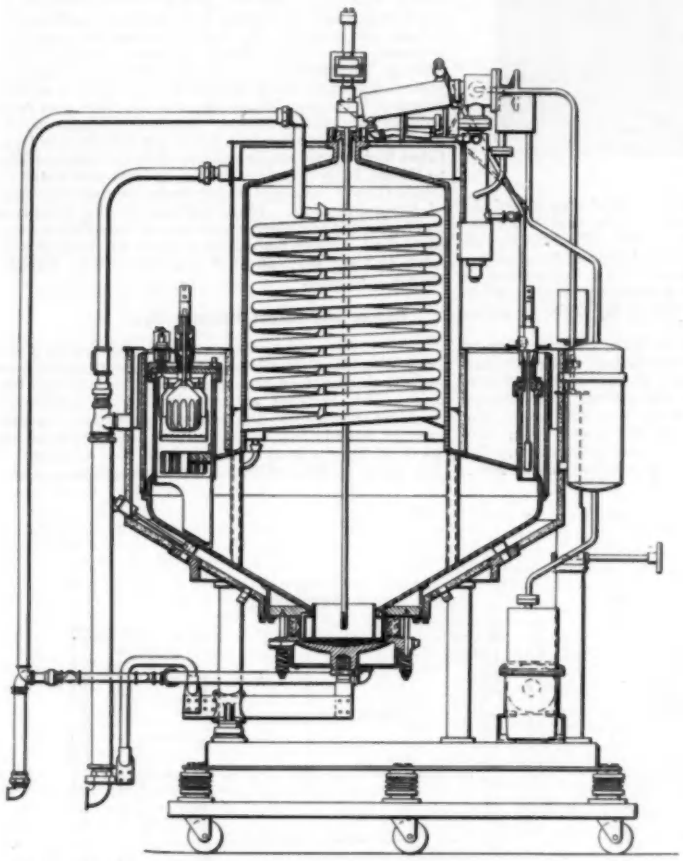


FIG. 1—SECTION THROUGH RECTIFIER

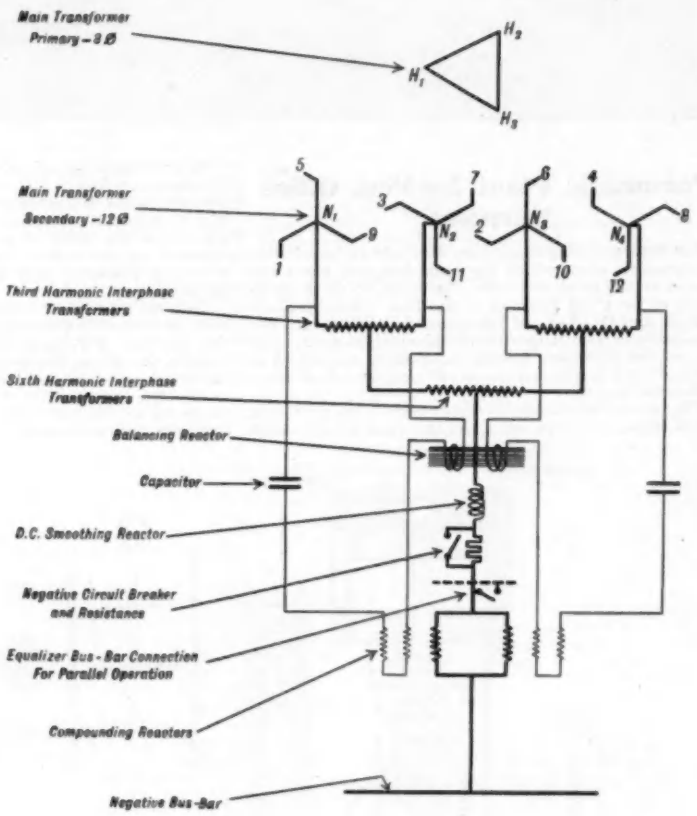


FIG. 2—COMPOUNDING CIRCUIT

THE Commercial Motor Users' Association has been informed by the Ministry of Transport that new regulations are shortly to be issued providing that the total weight of an existing four-wheeled steam wagon is to be increased from 12 tons to 14 tons, provided that its maximum speed, with or without a trailer, does not exceed 12 miles per hour, and that in the case of a steam wagon registered after January 1st, 1932, the total laden weight will be increased from 12 tons to 13 tons, provided that it is fitted with pneumatic tires on all wheels.

MAKING A QUARTZ MIRROR.

THE quartz mirror makers of the General Electric Company of America have completed the first experiment in producing fused quartz on a large scale. Up till now, it is said, the only experience of spraying quartz was that of laying down upon a 22in. disc a surface coating ⅛in. thick. The mass of quartz in the 66in. disc just completed, built up solely by spraying, weighs over 4000 lb. and is nearly 15in. thick. Owing to various imperfections incidental to the experimental nature of the work, it is not satisfactory for finishing into a mirror, but so much has been learnt while making it that very little doubt is felt of the possibility of producing not only another perfect 66in. disc, but also one 200in. in diameter for the astronomical mirror of the California Institute of Technology.

In order to use this method of construction many things had first to be discovered and many troubles overcome. A process for reducing the quartz from rock crystal to a powder with a definite grain size had to be developed, and the men trained till they were expert at the work and a special furnace had to be designed. The burner for this furnace mixes hydrogen and oxygen and the powdered quartz, which, melting under the heat generated, is sprayed on to the slab. The spray of quartz is heated almost to 4000 deg. Fah., while the slab is some 1500 deg. cooler. The burner is encased in a stout brass tube and water circulates round the pipes carrying the two gases and the powder to prevent them melting.

It has been estimated that the making of a 200in. reflector in glass would take about 15 years. Annealing of the mass required would alone take about 9 years, since the stresses set up in heating and cooling necessitate very gradual temperature changes. The first stage—the production of a flawless pouring of a sufficient quantity of molten glass—would take a considerable period of time. A quartz mirror, however, of this size can be made, it is believed, in no more than a third of the time.

B.E.S.A. SPECIFICATIONS.

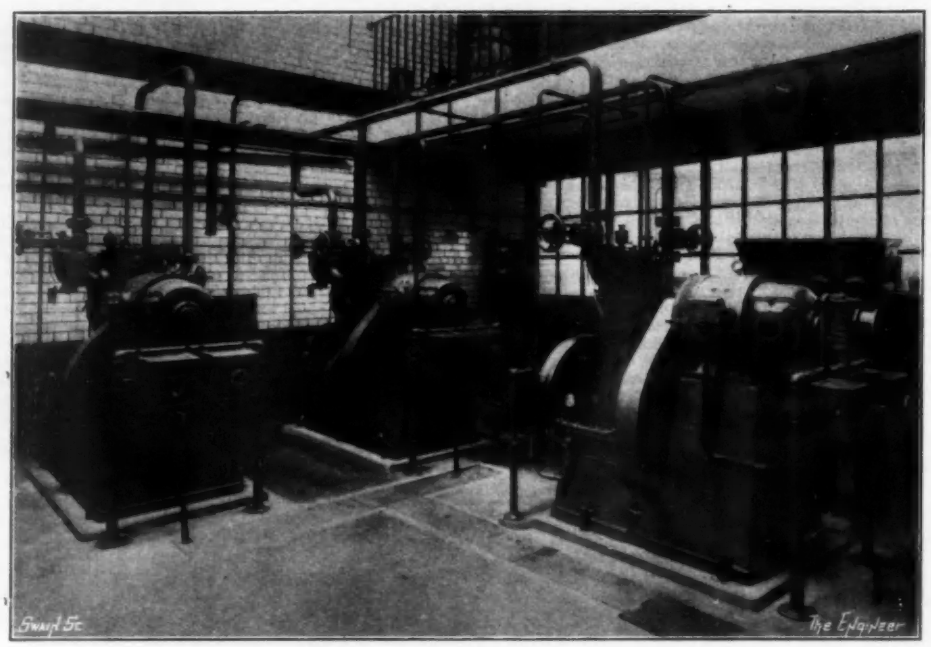
All B.E.S.A. Specifications can be obtained from the Publications Department of the Association at 28, Victoria-street, London, S.W. 1. The price of each specification is 2s. 2d. post free, unless otherwise stated.

STANDARD PIPE FLANGES.

THE question of the test pressure laid down in the B.S. Specification No. 10, part 3, 1929, has been the subject of consideration by a Committee of the British Engineering Standards Association. The test pressure of "one and a-half times the working pressure plus 50 lb." has been increased to "twice the specified working pressure." This increase in the test pressure will in no way affect any of the dimensions of the flanges or the bolt as at present specified. A revision slip relating to the revised test pressure has been prepared. Those who are already in possession of this specification—No. 10, Part 3, 1929—can obtain a copy of this slip—C.C. (ME) 3901—free of charge by making application to the Publications Department, British Engineering Standards Association, 28, Victoria-street, London, S.W. 1, enclosing a stamped addressed envelope.

PNEUMATIC PLANT AT GRIMSBY POST OFFICE

LACY-HULBERT AND CO., LTD., LONDON, ENGINEERS



Pneumatic Plant for Post Office Purposes.

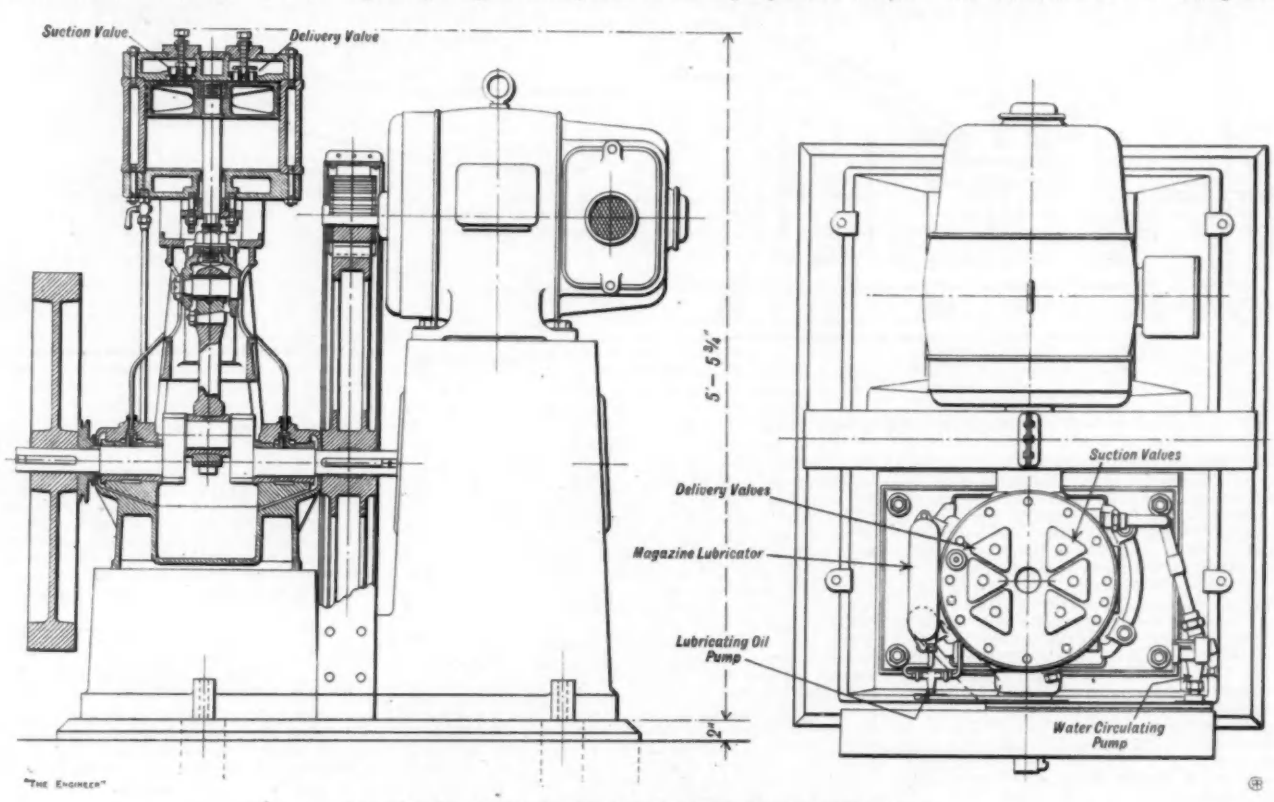
THE accompanying engravings illustrate an installation of pneumatic plant which has been designed, made and erected at the head post office, Grimsby, to the requirements of the Chief Engineer of the Post Office by Lacy-Hulbert and Co., Ltd., of London and Beddington. The plant has now been in operation for about eight months and has, we are informed, proved satisfactory and silent in operation and has shown an overall commercial efficiency of about 48 per cent.

The installation consists of three electrically driven sets, two of which have two cylinders, the third being a single cylinder unit. In all three cases the displacement capacity is 100 cubic feet per minute per cylinder. One cylinder of each of the twin-cylinder sets is connected to the pressure mains and is capable of drawing not less than 100 cubic feet of free air per minute from the atmosphere and discharging it to the pressure mains at 25 lb. per square inch absolute. The other cylinder of each of these two sets is connected to the vacuum mains and is capable of exhausting not less than 100 cubic feet of air per minute from the mains and discharging it to the atmosphere when the pressure in the mains is 7 lb. per square inch absolute. The single-cylinder set is a compressor unit and is capable of drawing the air at 7 lb. per square inch absolute and discharging it at 25 lb. per square inch absolute. The three sets can, if required, be arranged to work in parallel.

An automatic control valve is provided on each of the compressor cylinders and is so arranged that when the pressure in the mains rises above 26 lb. absolute the air inlet is closed until the pressure falls below 22 lb. absolute, whereupon the inlet is reopened. An adjustment is arranged in the control valves whereby each of these governing pressures may be varied by 2 lb. in either direction.

Each set constitutes a complete unit, the crank shafts being connected to their respective motors through reduction gearing. Fly-wheels on the shafts are provided to equalise the turning moment on the motors. The standard maximum speed of each crank shaft is 130 r.p.m., but means are arranged for varying the speed from two-thirds up to the full value. In the accompanying line engraving the arrangement of the single-cylinder set is shown. The two cylinders of the twin-cylinder units are identical with that illustrated. The cylinders and cylinder covers are water jacketed. Each unit is mounted on a bed-plate which carries the cylinder or cylinders, the motor, the gearing, and a guard for the gearing. The motors were supplied by Laurence, Scott and Electromotors, Ltd., and are of the enclosed ventilated type. They operate on a 460-volt D.C. supply. The motors for the two twin-cylinder sets are each capable of developing 7 to 10½ H.P. at 500 to 750 r.p.m., the control being of the shunt type. The single-cylinder set has a motor developing 5½ to 8 H.P. at the same range of speeds.

The lubrication of the sets is effected by means of a pump which draws the oil in each case from a sump and delivers it to a distributing box at the top of the cylinders, whence it is carried through sight feeds to every bearing. Any excess of oil is returned to the sump and is filtered for re-use. The switchgear is totally enclosed and ventilated. The starters are fitted with no-volt and overload releases, the no-volt coils being separately excited. A stop push button is included in the equipment.



SECTION AND PLAN OF SINGLE-CYLINDER COMPRESSOR UNIT

Canadian Engineering News.

All-rail Route Across British Columbia.

A THROUGH all-rail Canadian Pacific Railway service has been provided from Vancouver across the most southerly part of British Columbia to Lethbridge and Medicine Hat, in the province of Alberta, with the opening of a new rail link around Kootenay Lake between Proctor and Kootenay Landing. With its main line farther north, the completed southern route will give the C.P.R. two all-rail lines spanning British Columbia and connecting Vancouver with the Prairie Provinces. Previously the southern route was interrupted by the steamer connection on Kootenay Lake. The 30 miles of construction which was necessary to close the southern route through a part of the Rocky Mountains, was one of the most difficult pieces of railway construction undertaken in Canada in recent years.

Ambitious Aviation Scheme.

Preliminary plans for aviation routes that will make Canada an effective factor in international aerial communications, involving both Europe and Asia, were announced recently at the conclusion of a conference between Post Office officials of Canada and the United States. The first step in the programme has been taken with the definite decision to put into effect an aerial link between Winnipeg, Manitoba, and St. Paul and Minneapolis in the United States. Subject to approval by the heads of the departments, a service will shortly be instituted to carry passengers and mail from Calgary, Alberta, to Miami, in the Western States, in forty-two hours. This would effect a saving of ninety hours over present methods of communication. While details of the Winnipeg-St. Paul schedule were being worked out the officials were also discussing a more ambitious scheme to develop a route from Calgary through Fort McMurray into Alaska and thence into Asia.

Copper and Nickel Tonnage Up.

The output of copper and nickel from the Sudbury district of Northern Ontario continued to increase rapidly during the year, despite the general world depression. This increase applies also to the production of precious metal from the mines of Sudbury. In the ten months ended October 31st, 1930, the output of copper reached approximately 115,000,000 lb., compared with less than 70,000,000 lb. in the corresponding period of 1929. During the ten months referred to the output of nickel reached 102,000,000 lb., compared with about 95,000,000 lb. for the first ten months of the preceding year. The ore during the last year has yielded slightly under 3 per cent. copper and a little over 2½ per cent. nickel.

Zinc Refinery.

THE Superior Zinc Corporation, of Canada, has started construction on a secondary zinc refinery in Toronto to supply the domestic demand in Eastern Canada for zinc oxide, zinc dust and spelter. The refinery is being built as the result of negotiations carried on between Alfred Davis, of the Canadian Rumley Company, Ltd., and the

Superior Zinc Corporation, of Philadelphia, a large secondary zinc refining company of the United States. It is expected to have the new plant in operation by the middle of April.

Civil Aviation in 1930.

Civil aviation in Canada, particularly commercial flying, made steady progress during 1930, and an estimated grand total of 87,453 hours were flown, which is an increase of approximately 7667 hours over the previous year. Returns from nineteen principal commercial operators, three mining companies, and the Ontario Provincial Air Force show that a total of 52,621 hours was flown by these concerns, a mileage of 4,350,970 covered, and 55,961 passengers and 1,449,337 lb. of goods carried. An estimated total of 20,000 hours was flown by 115 other commercial operators, and twenty-three light aeroplane clubs, with 14,832 hours, accounted for the balance of the flying time. Three additional air mail routes were established in Canada during 1930, bringing the total to nineteen, and were operated by seven companies under contract with the Post Office Department. Forest fire patrols, air photography, air mail investigations, &c., are important operations carried out by the Directorate of Civil Government Air Operations. Approximately 13,546 flying hours were spent in connection with these activities in 1930. Private pilots in Canada at the end of 1930 numbered 309 and commercial pilots 402. There were 370 air engineers, 495 aircraft, and 69 air harbours.

Noranda Copper Refinery.

Operations have commenced at the large electrolytic plant of the Canadian Copper Refiners, Ltd., at Montreal West, widely known as the Noranda Refinery. The plant, which is a joint enterprise of the Noranda Mines, Ltd., the British Metal Corporation, of London, England, and the Nichols Copper Company, of New York, was built to handle the blister copper from the Noranda smelter and other sources. At normal speed and full capacity the refinery can produce 75,000 tons of refined copper annually. The main building of the refinery is 1040ft. long and 264ft. at its greatest width, and contains 432 commercial cells and 36 stripper cells. The tanks, when full, have a capacity of 14,000,000 lb. of copper. It will take quite a number of weeks to accomplish the full loading and the first refined copper is not expected to come on the market until towards the end of April.

Important Power Contract.

Faced by engineers' predictions of a possible power shortage in Ontario in 1936, the Hydro-Electric Power Commission of Ontario has reached out to tap another Quebec power source in a contract with the Maclaren-Quebec Power Company for the delivery of 125,000 horse-power of electric energy, at a cost of 1,875,000 dollars per year. The power will be secured from the company's new hydro-electric development, on which construction is about to start, at Masson Falls, about 17 miles east of the city of Ottawa. The Masson Falls development is the fourth power source to be tapped by the Ontario Hydro in the Ottawa-St. Lawrence district. The other three are the Gatineau River developments, Chats Falls on the Ottawa River, and the Beauharnois development on the St. Lawrence. The power included in the contracts with the companies controlling these four developments totals about 1,000,000 horse-power, all of which will serve to meet Ontario's increasing demands for power for industrial, domestic, and rural use.

The Copper Situation.

In an industrial picture of varying light and shade, one bright spot, at least, stands out as marking an important turning point in Canadian affairs. This is the fact that in 1930 Canada achieved independence in copper. So far as a supply of metal is concerned the Dominion is independent of the world. Ore reserves in the Frood Mine of the International Nickel Company are considered ample to supply the requirements of Canada for copper on its present scale of consumption for the coming century. There are other important producers. Another important point is that Canadian copper reserves are found with other metals of economic importance. This factor, coupled with the extent of the metallurgical facilities, assures Canadian mines of steady operation at a profit when many other of the world's higher cost producers may have to close. The importance of copper to Canada at the present time is revealed in figures for 1929 showing imports of various forms, including brass, scrap, and copper in wires and cables, totalling 98,000,000 lb. It has been estimated that by mid-year the Dominion should have a total capacity for refining some 410,000,000 lb. of copper. Though Canada has ore reserves and metallurgical facilities for producing refined copper far in excess of domestic requirements, there are comparatively few fabricating plants within the Dominion. Hence the decision of the Canada Wire and Cable Company to utilise the advantage of proximity to a source of refined copper at Montreal East is regarded as significant and probably indicating a future trend for the copper industry.

Smoke Abatement.

After a careful study, covering a period of about two years, the city of Montreal has adopted a new smoke abatement by-law. One of its features is the establishment of a special smoke inspection department, headed by a competent official, who will have as a standard test an official smoke chart intended to prevent dense black fumes from floating over the city. The official chart to be used by the smoke inspector for determining the degree of density or shade of the smoke will be the "Ringleman Smoke Chart," as published and used by the United States Bureau of Mines. The by-law provides that any stationary or moveable machinery or apparatus of any capacity whatever, emitting smoke, will be subject to the provisions of the by-law, and the measure stipulates that all such machinery or apparatus must use coke.

The First Welded Ocean-going Ship.

THE first ocean-going ship welded throughout was the motor ship "Fullagar," and she has now been in service for eleven years. We recently received from the Quasi-Arc Company, Ltd., of London, the following brief history of the vessel to date, the facts of which have been contributed by her several owners during the period named.

The "Fullagar," since renamed the "Caria" and later the "Shean," was built by Cammell Laird and Co., Ltd., at Birkenhead and was launched in February, 1920. We described the ship in our issue of July 16th, 1920. She has a length between perpendiculars of 150ft., a breadth moulded of 23ft. 9in., and a gross tonnage of 398 tons, with a speed of 10 knots.

On her completion she was classed 100 A 1 Electrically Welded, Subject to Annual Survey, Experimental; and went into service with her owners, T. and J. Brocklebank, Ltd., of Liverpool, in July, 1920. Later she was acquired by the Manx Isles Steamship Company, Ltd., and was renamed the "Caria." During the ship's career with these companies she passed through very strenuous services in the coastal trade, carrying various cargoes, such as steel plates, coal, maize, &c., and on several occasions was in service during heavy weather whilst other vessels of the same size remained in port. The ship has been aground through stress of circumstances several times, and on each examination later in dry dock the keel and bottom plating were found to have withstood the excessive strain of grounding without any ill effects to the welded joints, and on no occasion was there any leakage through the shell. In June, 1924, a serious accident occurred to the vessel which has in a striking manner proved the superiority of a welded ship over a riveted ship.

The vessel went aground on a sand bank in the Mersey during a voyage from Liverpool to Belfast when fully laden. She floated off on the next tide, and as she was quite water-tight she proceeded on her voyage and discharged her cargo at Belfast. It was then found that she was damaged to a considerable extent, but as the shell was water-tight, it was decided to take her back to Liverpool under her own power. When docked, the vessel was thoroughly examined and by using sights the bottom was found to be set up 11in. from bilge to bilge over a length of roughly 70ft., and from the evidence of inside structural work, she had been set up more, but had settled when placed on the blocks.

Whilst in dock in this condition, the vessel was thoroughly examined by Lloyd's surveyors, representatives of the underwriters and owners, also Admiralty officials, who were greatly interested, and the opinion was expressed that not only had the welding stood a remarkable test, but, which is of greater importance, that had she been a riveted ship she would have been a total loss.

Afterwards, the vessel proceeded under her own power to Leith, where an official survey was held, and the scheme of repair decided upon.

Notwithstanding the drastic experience to which the ship has been subjected, it is very interesting to note that the vessel's classification standing in Lloyd's Register Book as 100 A 1 Electrically Welded, Subject to Annual Survey, Experimental, has been retained without qualification.

The vessel, although she was originally designed as a coaster, after passing through all her vicissitudes, was still in such a satisfactory and seaworthy condition that permission was given for her voyage across the Atlantic and through the Panama Canal to the North Pacific coast, where she has since been employed in the cement-carrying trade, the new owners being the British Columbia Cement Company, of Victoria, British Columbia, who have renamed her the "Shean." The "Shean" struck a rock cliff in the Saanich Inlet, near Victoria, British Columbia, when going at full speed, with 10,000 bags of cement on board. On examination of her hull after the accident, it was found that in no case did the plates tear apart at the welds, but above and below in the solid plate. Both Lloyd's and the underwriter's surveyors stated that the relatively slight amount of damage was a remarkable tribute to the welded vessel.

After more than eleven years' prolonged exposure of the welds to corrosive action of sea water, it is now impossible to trace undue corrosion of metal in any part of the structure, which is in such a satisfactory condition that Lloyd's have agreed to a biennial survey.

CONTRACTS.

RICHARD DUNSTON, Ltd., of Thorne, near Doncaster, has received an order for a large motor barge for general cargo service on the rivers Humber and Trent.

THE VAUGHAN CRANE COMPANY, Ltd., of Openshaw, Manchester, has received an order for three overhead electric cranes from the Dublin Port and Docks Board for its tobacco warehouses.

THE HUNSLET ENGINE COMPANY, Ltd., of Leeds, has received an order for eight locomotives 0–6–0 type, with 14in. by 20in. cylinders, for work at Southampton graving dock, by J. Mowlem and Co., Ltd.

RUSTON AND HORNSBY, Ltd., have received an order from the Ashford Urban District Council for a six-cylinder, 1200 B.H.P., Ruston vertical oil engine, supercharged, for an extension to the Council's power station.

THE CLARKSON THIMBLE TUBE BOILER COMPANY, Ltd., has booked contracts with Harland and Wolff, Ltd., for two boilers for the main engines of the m.v. "Georgic," and an exhaust gas and oil-fired boiler for a Nelson liner now being built.

CATALOGUES.

BUTLER MACHINE TOOL CO., Ltd., Victoria Ironworks, Halifax.—Catalogue 15, entitled "Machining of Railway Axle Boxes," and a booklet of photographs of the firm's latest products, which include planing, shaping and slotting machines.

BURTON, GRIFFITHS AND CO., Ltd., Montgomery-street, Sparkbrook, Birmingham.—Catalogues of 1L and 2L high-production turret lathes and Greenerd arbor presses. A catalogue on the Blanchard high-power surface grinding machine.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondents.)

Whitsuntide.

ACTIVITY in Midland and Staffordshire industries has this week been slight, and, in some branches, negligible. A portion, if not the whole, of the week has been given over to holiday-making, there being few orders on the books which necessitated an early resumption of work. It was hoped that fresh orders would be received during the stoppage, but inquiries made just prior to writing fail to elicit news of any great bulk of business having come to the chief industrial concerns in this area. Since such is the case, it will be immediately recognised that the trade situation here is, at date, much the same as set out at some length in my letter last week. Apart from the suspension of price control in the galvanised sheet trade, there has been no change in market prices of iron and steel. A very small amount of business has been transacted, most works having sufficient material at their disposal to satisfy their immediate needs. Next week, however, there should be some additional buying and increased market interest, though we are now fast approaching the period of the year which normally affords less activity to Midland industries than do the other nine months of the year. This falling off in business during the summer months is not now so marked as it was when the Midlands were more exclusively engaged in the production of iron and steel and heavy engineering products than they are to-day. The rapid growth of the lighter side of manufacture in this area has brought an all-the-year round activity which helps the area to carry on through June, July and August. There seems no limit to this district's initiative in taking up new lines of manufacture, and there are few areas which can claim such a multiplicity of trades. When the present trade slump comes to an end, there should be unbounded prosperity in store for the Midlands. The enterprise of its industrialists and their dogged determination and persistence must, one feels sure, bring their reward. Between now and the August holiday break there is small prospect of anything in the nature of a real trade revival for the basic industries, but with the third quarter of the year it is confidently anticipated that there will come additional activity which it is hoped will be backed by such confidence as to turn it definitely into a trade revival.

Price Control Removed.

The removal of price control in the galvanised sheet industry has unsettled that market, and until the new situation has found its level it is almost impossible to tell where the new basis of prices will come to rest. At date quotations vary considerably. Some local mills are asking £10 10s. per ton for galvanised corrugated sheets of 24 gauge, while others are reported to be quoting as low as £10 5s. These figures show a considerable drop on the price ruling before control was suspended. They represent a fall in value of from 10s. to 15s. per ton, and, as stated above, it is far from certain that they will remain even at this level. Buyers and sellers have this week been actively engaged in trying to fathom the new situation. Few orders have been placed as yet, consumers holding the opinion that with unrestricted competition and excess of production, they will probably be able in the near future to fix their own terms. At any rate, they have this possibility in mind, and are holding off the market for the time being. It is believed that the lower range of prices will stimulate export buying and manufacturers are looking for increased orders from Australia and India.

Tin-plates.

The tin-plate pool comes to an end next month, all efforts to keep it going having apparently failed. There is no improvement in demand in this area, and even offers made this week of supplies at 14s. 6d. were not taken up.

Raw Iron.

Black Country foundrymen are themselves so poorly supplied with orders that they have been unable to respond in any marked degree to the blast-furnacemen's call for more business at cheaper prices. Though users in this district are now more satisfied with the price level of raw iron, they hesitate to buy in advance of actual requirements. Until there is some improvement in demand for the manufactured goods, therefore, there seems little chance of much benefit reaching Midland smelters. It is reported that some district founders are willing to pass on the price reduction and that they have already quoted lower prices for castings. Both parties are endeavouring to increase sales, and it is hoped that there will eventually be some response. Stocks of iron at Derbyshire and Northamptonshire furnaces are being kept down, and they do not in many cases now occasion alarm. The business transacted this week, such as it was, was put through at the fixed figures—Derbyshire foundry, £3 6s.; forge, £3 1s.; Northamptonshire No. 3 foundry, £3 2s. 6d., and forge, £2 17s. 6d.

Staffordshire Bar Iron.

There has been little movement in the Staffordshire bar iron industry this week, holidays having been of a protracted character at most of the mills. Sales have been for small tonnages and mainly confined to best grade bars. Values are unchanged at £12 for marked bars, £9 5s. to £10 5s. for Crown bars, £8 12s. 6d. for nut and bolt and fencing bars, and £10 7s. 6d. for wrought iron tube strip.

Steel.

The steel trade presents an unfavourable appearance. Business drags in all departments, and the market, alike for finished and semi-finished material, is inactive. The consuming engineering industries are short of contracts and specifications are difficult to obtain. Especially

is this the case in the structural engineering department. Finished steel prices are upheld by the makers' Association, but it is thought that they may be lowered when the position is again reviewed in the near future. Values tend to weaken further in the half-products branch, and buyers claim to have bought from local re-rollers small steel bars of foreign make at £6 15s. per ton. It is also stated that pressure brings a reduction of half-a-crown in the case of mild steel billets, and that although quotations may be five guineas, £5 2s. 6d. is accepted by some sellers when the order is offered at that figure. It is difficult to determine the actual market level of steel semis at date. Steel scrap is greatly in excess of demand, and is reported to be almost unsaleable.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Textile Machinists to Merge?

SIR GEORGE BULLOUGH, at the recent annual meeting of Howard and Bullough, Ltd., textile machinery manufacturers, Accrington, cleared the way for an early announcement concerning the merging of interests of Lancashire firms engaged in this branch of the engineering industry. The announcement came, however, a good deal sooner than many people expected, for no more than a week after Sir George's intimation that "negotiations are in progress with a view to finding some means of conserving the industry," an official statement was published here that a scheme of amalgamation embracing six Lancashire firms had been prepared, and was to be submitted to the shareholders of the various concerns. No details are yet available as to the basis of the proposals, but it is certain that they are more likely to meet with general acceptance than on previous occasions during the past year or two when schemes with a similar object in view have been under discussion. Apart from other considerations, the position of these firms has become worse rather than better, and when recent operations have not resulted in an actual loss, the profits have been on a much reduced scale. Dwindling markets at home and abroad have been largely responsible for this condition, with serious price-cutting for the business available as another important factor.

The Firms Concerned.

The six Lancashire firms of textile machinists whose interests are involved in the draft scheme are Platt Brothers and Co., Ltd., Oldham; Howard and Bullough, Ltd., Accrington; John Hetherington and Sons, Ltd., Manchester; Brooks and Doxey (1920), Ltd., Manchester; Dobson and Barlow, Ltd., Bolton; and Asa Lees and Co., Ltd., Oldham. The total authorised capital of the six concerns amounts to rather more than £8,500,000, of which £7,320,000 has been paid up. All of the firms are old-established and have a world-wide reputation as textile machinists, Platt Brothers being the largest and accounting for a little over half of the total paid-up capital. Tweedales and Smalley (1920), Ltd., Castleton, near Rochdale, who are also very well known in the Lancashire textile machinery industry, are not affected by the proposals, and a number of smaller concerns are also outside the scheme.

Non-ferrous Metals.

Although weakness still seems to be the keynote, the non-ferrous metals market during the past week, with its somewhat violent price fluctuations, has presented a number of interesting features. First and foremost has been the fresh collapse in the tin section, after two successive weeks in which, on balance, some degree of recovery was registered. The decision to reduce production of the metal still further sent up values rather appreciably, but since then rumours of dissension among producers have had a pronouncedly "bearish" influence on the market. Not only has the whole of the advance been lost, but prices have been forced down to within dangerous proximity to the £100 mark, prices current at the moment of writing being about £21 a ton below the mid-March quotation, which was the highest point touched this year. Apart from speculative transactions, interest in tin has continued on a very moderate scale. In the case of copper, a slight improvement is reported in one or two sections of the consuming industries, but there has been no apparent expansion in the demand for the metal, and with the supply position obviously top-heavy the standard market has sustained a fresh fall of about £1 a ton, which brings current values to a lower level than for about forty years. A little more interest in spelter is reported in certain quarters, and prices have moved up to the extent of about half a crown. This is the only non-ferous metal section that has been relatively steady druing the past week, for heavy supplies of lead and a poor demand have between them brought down prices still further, the drop on balance amounting to about 5s. a ton.

Iron and Steel.

Dullness in the Lancashire iron and steel markets has been accentuated by the influence of the holidays, and with many works in the district wholly or partially closed down, the movement of both pig iron and steel products has been on a correspondingly smaller scale, with new bookings of all descriptions of material largely suspended. There has been no quotable change in the price position, however, although in one or two instances where products are free from control, the tendency at the moment is the reverse of strong. For delivery equal to Manchester, Derbyshire, Staffordshire and Cleveland foundry irons are all quoted at 67s. per ton, with Scottah obtainable at from 88s. to 88s. 6d., and West Coast hematite at about 82s. 6d. Sales of finished iron are poor, with Lancashire Crown bars quoted at £9 15s. per ton, and second quality material at about £8 5s. Just before the holiday interruption one or two moderate-sized parcels were disposed of in the steel market, mainly for constructional purposes, but there has been no apparent general improvement in the position of firms in this branch, whilst in boilermaking and locomotive building also the position is unsatisfactory. Acid and basic quality boiler plates are both quoted at from £8 17s. 6d. to £9 per ton, according to quantity, small re-rolled bars at about £6 15s., joists at £8 15s., sections at £8 7s. 6d., general plates at £8 17s. 6d., and 3in. bars at £9 7s. 6d. Continental iron and steel products are finding slightly lower levels, but business in these materials at the moment is largely of a retail character.

BARROW-IN-FURNESS.

Hematite.

At present the demand, both local and otherwise, for hematite pig iron is not sufficient to absorb the output from the eight furnaces now in blast; hence, stocks are beginning to rise, which is unfortunate. Some months ago, when the local steel departments were doing very little, the stocks began to accumulate, until the total tonnage ran into six figures. There came relief in the form of a slightly better demand for iron and a restarting of the rail mills at Workington and Barrow. These factors had the effect of checking the increase of stocks; but now the business in pig iron is quiet and the rail mills are not fully engaged. The possibility of damping down is, at the moment, not being seriously considered, as there are still hopes for improvement in the demand for both iron and steel. If the business with Scotland and South Wales in pig iron would only improve, the question of stocks would not be such a serious one. The Midlands district is the best customer for iron at present. Continental business is moderate, but is maintained, while American orders are on the light side. As regards iron ore, there will be no improvement until there is a better market for pig iron. The steel market is quiet, but there are hopes that new orders for rails will shortly come along. Both home and foreign requirements are known, but the financial side of the business is difficult with regard to the placing of contracts. This remark applies particularly to foreign requirements.

SHEFFIELD.

(From our own Correspondent.)

A Depressing Holiday.

THERE is little to say about actual operations at the Sheffield works this week, for the simple reason that in most cases those operations have not taken place. The Whitsuntide stoppage is a long one, most of the large establishments having suspended production for the whole week, while in a few cases the holiday is being prolonged to ten days. There are a few instances in which the break is shorter, and, generally speaking, the date of resumption will depend upon the extent to which orders come to hand during the suspension. The quantity of work left in progress or on order when the works closed down was moderate in some cases, poor in many, good in few. The outlook was not by any means promising, as, apart from the scarcity of substantial orders, inquiries of importance were few, and there was nothing to suggest an early resumption of buying on anything like a satisfactory scale. On the whole, it cannot be said that there is anything in the state of trade to add cheerfulness to the holiday spirit, but quite the reverse.

A Statesman on Sheffield.

The extent of Sheffield's difficulties is old news to readers of THE ENGINEER, but it is not always appreciated by the general public. It was therefore all the more satisfactory to hear a tribute paid to the city on Whit-Monday by Mr. Stanley Baldwin, who is prepared, when he has the power, to do a great deal for the safeguarding of her industries. He referred to the city as a melancholy example of what has happened during post-war years. He pointed to the way in which all classes of the people during the war threw themselves into the munition work which was so essential to the country; and added that no city in England had suffered more since the war than Sheffield. On this one may comment that Sheffield has not suffered through its own fault. Since the war it has done its utmost to adapt itself to new conditions, and to expand its peace industries in order to make up for what it lost in armaments; but the process of recovery is slow and variable, and at present it is in the trough of one of the deepest waves of depression. When it will rise to the crest cannot be foreseen. It will not be assisted by treatment such as it has received from the present Government, which took away the Safeguarding Duty on cutlery that had been granted by its predecessors. It has much ground for hope in the knowledge that the policy for which Mr. Baldwin stands will be of inestimable help to it.

Round the Works.

An open-hearth furnace has been put into commission by the English Steel Corporation at the Grimsthorpe Works of the Cammell Laird branch, but generally output remains at the previous level, and firms are having difficulty in disposing of the production, limited though it is. In Lincolnshire, a slight change for the worse is reported, There have been reductions in the quotations for pig iron and all classes of billets during this month. There is keen foreign competition in some classes of steel, and cases are reported of foreign hard basic billets being offered at pre-war prices. Demand for steel supplies from the British railway companies continues to fall, and the trade in wagon building for private owners is moribund. There are few railway orders on hand from India and South America. There are no heavy engineering contracts of importance on hand at present.

Stainless Materials.

One of the few cheerful branches of local trade is that devoted to the production of stainless and corrosion-resisting steels. While the continuous progress of past year is not maintained, the trade is still on a very substantial scale, and orders from home and abroad come to hand with fair regularity. The branch is hit by the world depression, but not to anything like as large an extent as many others. The applications of stainless and rustless materials to industrial purposes are continually growing in number. Both this trade and that in alloy steels have a good deal to hope for in the progress of aviation. Brown Bayley's Steel Works, Ltd., have recently executed an interesting stainless steel commission for the Continent. This was the production of an absorption column for use in connection with chemical plant, consisting of a cylinder 41ft. high and 5ft. 6in. in diameter, of riveted construction. The vessel was tested to a pressure of 176 lb. The same firm has recently supplied to a Lancashire house a set of stainless steel steam-jacketed pans to hold 40 gallons. Such pans are used for boiling jam and various foods, and stainless steel has been found suitable for the purpose.

A Steel Firm's Report.

The extent to which the steel industry has declined during the past twelve months is shown by the annual report of the Park Gate Iron and Steel Company, Ltd. During the year ending March, 1930, the company had a record output of steel ingots, and the profit was sufficient to extinguish a debit of £37,772, and to leave a little to be carried forward. For the period ended last March, however, the story is very different. The directors explain that the depression in trade and intense competition reduced the orders which the company could obtain, so that the output of steel ingots was only 72 per cent. of that of the previous year. In addition, selling prices of finished steel have fallen faster than those of raw materials. A net profit has been made, but it is only £8209, which is to be carried forward. A part of the scheme of works improvements and additions referred to in previous reports has been completed, and has proved of distinct value. Expenditure on the remainder has been deferred in view of trade conditions. The directors consider that, in view of the year's handicaps, the results are by no means unsatisfactory, and show that the expenditure on the improvements have been well justified. They have reduced the amount of their remuneration for the year from £3000 to £2000. The last dividend paid on the company's shares was 7½ per cent. for 1920–21. The paid-up capital is £1,850,000.

Machinery for Russia.

A substantial order for machinery for Russia has just been booked by Marshall, Sons and Co., Ltd., of the Britannia Ironworks, Gainsborough, and work is to begin on it at once. Last year the firm completed a small order for the same country, and the present one follows orders of a similar kind placed with a Lincoln firm.

The Lighter Trades.

The automobile builders are still taking fair supplies of forgings and stampings from Sheffield, especially for commercial vehicles, but the volume of work is not equal to that of a couple of years ago. For cold-rolled steel and strip, which for some time until recently was a strong department of local trade, there is now only a moderate demand. The shortage of overseas orders for alloy steels and tools is as acute as ever, and is one of the principal factors in contributing to the great difficulties of these departments. The requirements of the home market are only moderate. There is no improvement to be recorded in the market for ferro-alloys. Steel makers show no disposition to place forward orders, and the quantities going into consumption are the smallest recorded for years past. There has been very little activity at the cutlery and plate works during the past week, and conditions remain at the unsatisfactory level stated in my last report.

A New Reservoir.

The Dearne Valley Water Board is constructing a new reservoir, to serve a large area of the Dearne Valley at Roebuck Hill, Jump, a few miles from Barnsley. The first sod was cut last week. The capacity of the reservoir will be 1,000,000 gallons, and it will replace an old service reservoir which held only 87,000 gallons. The cost will be £9100, towards which assistance is being received from the Unemployment Grants Committee. Mr. Bernard Geen is the engineer, and the contractors are Messrs. William Lovatt and Co., of Wolverhampton.

NORTH OF ENGLAND.

(From our own Correspondents.)

Big Northern Mines Plan.

A LARGE scheme of colliery mechanical development is at present being financed by a Northern combine of pit equipment manufacturers, including Hugh Wood and Co., of Newcastle, the Metropolitan-Vickers Electric Company, Ltd., and British Jeffrey-Diamond Ltd. The scheme is being arranged on a pay-by-result basis, and when it is completed about 20 collieries will have been dealt with. Machinery costing hundreds of thousands of pounds already has been introduced into districts of twelve Northern pits. Low seam work is being specialised in, and seams which hitherto have been considered too small for machine working have been undertaken successfully with coal cutters only 14in. high. Work already has been started in the 21in. Beaumont seam of the Dunston pit, which is one of the smallest seams to be worked by machinery. Another seam there is to be opened shortly with similar appliances. Cutters, conveyors, mechanical haulages, and electrical equipment costing about £20,000 have been installed in this mine, and steel supports instead of wooden pit props are being used.

Large Order for North.

An order for a large instrument outfit, stated to be the largest of its kind in the world, has been placed with the Fox Instrument Company, Ltd., of Newcastle-

upon-Tyne, for the Dunston power station. The instrument is, together with many thousands of feet of copper tubing and electric cable, intended for measuring the depth and tonnage contents in the many tanks and hot-wells of the power station, at the same time giving an electric signal when the tanks are nearly full or empty. It will enable the operating engineers in the turbine-house to see at a glance the position of the liquid in any of the tanks and hot-wells throughout the station. The instrument is similar to that used extensively by the British Navy and supplied to many large power stations in various parts of the world.

Cleveland Iron Trade.

There is little change of moment in the condition of things in the Cleveland pig iron trade. The market is dull, and the continued absence of early change for the better is causing grave concern. Consumers are still showing little inclination to place orders for metal, except for small tonnages to cover their immediate needs. Stocks, however, are not large and are not increasing to any extent, the limited make being largely absorbed at producers' own works. Second hands are not in a position to put through much business. Their holdings are small, and overseas demand is trifling. More Midland iron is coming forward for consumption in this area. Makers of Cleveland pig iron are still unsuccessful in their effort to recapture trade with Scotland, though they offer supplies at substantial concessions on home prices. No. 1 Cleveland foundry iron is 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

East Coast hematite pig iron is in ample supply. Buyers are seeking price concessions and are making only small purchases. Second hands are anxious to lighten their holdings and readily accept low prices for small export orders. Producers continue to do a little business with consumers in the Sheffield district. Stocks are heavy at certain works. Ordinary qualities of hematite are on sale at 65s., and buyers state they experience no difficulty in placing orders at less.

Ironmaking Materials.

Business in foreign ore is virtually at a standstill, consumers being well stocked. Best Rubio ore is nominal at 15s. 3d. c.i.f. Tees. Good medium blast-furnace coke is easy at 15s. 6d. to 16s., delivered at North-East Coast works.

Manufactured Iron and Steel.

The feature of moment in the manufactured iron and steel trade this week is the fact that the system of controlled prices for galvanised sheets has been abandoned, and a free market has been declared. The immediate result is that the price of sheets of 24 gauge has fallen by 10s. to £10 10s. per ton, and it is hoped that this may give an impetus to overseas trade. No change has yet been made in the price of black sheets, which remain at £8 10s. Most of the works were closed down two days this week for the holidays. Makers of heavy steel complain of acute scarcity of new business, and buying all round is very quiet.

The Coal Trade.

There is no sign of any animation in any branch of the Northern coal trade, and no pressure is felt for any loading position. Merchants see little new business for some weeks ahead. Northumberland steam coals are quietly steady at 13s. 6d., and in good supply. Steam smalls are neglected, and with ample stocks prices are nominal for best qualities at 7s. 6d. All classes of Durham gas fuel offer freely, but little support is forthcoming, and the undertone remains easy. Best gas hold steadily to 14s. 6d., and secondary gas at 13s. 6d. Best class bunkers are in quiet demand and steady at 13s. 9d. to 14s. Second bunkers are plentiful and weakly held at 13s. 6d. Coking unscreened are neglected at 13s. 3d. Gas coke has moved more freely and makers are more booked up over the next week or two, but could handle additional trade. Prices are easy and unchanged at 19s. Patent oven coke is in slow demand, and with ample stocks freely offered at 15s. Superior foundry coke is a slow trade, and values are easy at 19s. to 22s.

SCOTLAND.

(From our own Correspondent.)

Difficult Conditions.

In all branches of the steel, iron and coal trades conditions are most difficult. Consumers at home are not in a position to increase their purchases, and overseas buyers show little interest meantime. The general inquiry has on occasion speeded up a little, but as a rule without tangible result, and business on the whole continues on restricted lines with little or no indication of improvement.

Steel.

It is said that in one or two instances the tonnages specified has been better of late, but it is not implied that the increase will be sustained. On the whole, plants are working far below normal capacity. Demands for heavy steel, more especially for shipbuilding materials, are especially disappointing, and the pronounced shortage of work at the yards is rather discouraging. Some fair inquiries for structural steel have been reported. In spite of the fact that the price of black sheets has been reduced 10s. per ton, business has not shown any tendency to increase. Galvanised descriptions, too, are rather disappointing, especially in respect to the export turnover. Although there has been a slight improvement in sheets, business on the whole continues at a low ebb, and the majority of the works are on short time.

Iron.

The iron market continues absolutely without encouragement. Bar iron remains at the "agreed" price for home delivery, but there is a tendency to weakness in export, which at present stands around about £9 15s. per ton. There is little activity in re-rolled steel bars, with prices remaining at £6 10s. home and £6 7s. 6d. per ton export.

Pig Iron.

Supplies of pig iron are plentiful, despite a very low output, owing to the restricted demand and continued imports from India and the Continent. In Scotland only seven furnaces are in operation. Shipments of pig iron from Glasgow last week amounted to 184 tons (121 tons foreign), compared with 341 tons (293 tons foreign) in the same week last year.

Scrap.

The market for scrap shows further weakness, with heavy steel at 41s. 3d. and cast iron machinery 50s. per ton.

Coal.

The Scottish coal market is without any sign of improvement. Home demands continue to diminish as the season advances, and the collieries in all districts are very short of orders. Foreign inquiries as a rule are restricted to small prompt lots, and only a limited number of orders are being booked, owing to keen competition abroad. Forward transactions are practically impossible, as shippers are unable to name prices likely to interest foreign importers. Most, if not all, qualities of fuel are easily obtainable for prompt delivery, and prices as a rule still show an easier tendency. Aggregate shipments amounted to 200,188 tons, against 207,112 tons in the preceding week, and 241,647 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

The holidays have intervened to make the conditions in the steam coal trade more unsettled than ever, and it will be next week before the position can be properly gauged. As the result of arrivals of tonnage, the situation from this point of view for the collieries, is by no means too satisfactory. The exodus of tonnage last week was fairly heavy, as may be seen from the fact that on Saturday the official return of idle tipping appliances at the various docks showed that the number was 53, which is the highest figure recorded this year. At the same time, there was no holiday rush for coals and no abnormal loading pressure, and shipments of coal varied very little from the average of previous weeks, the total being 493,700 tons, an improvement of 24,000 tons on the previous week. Unfortunately, so far as can be seen, little fresh inquiry has come on the market over the holidays. New orders are very restricted, and it looks very much as if the market will continue very much upon the lines of the past month or so. A much better demand for supplies for current shipment is necessary in order to infuse activity into the market and raise prices above the level of the scheduled minima. There are, however, a few inquiries about for supplies on contract. Tenders go in at the end of this month for 200,000 metric tons of locomotive coals for the Egyptian State Railways for delivery over a period of about four months, and the Paris-Orleans Railway of France are inquiring for prices for various quantities for delivery over one or two years, while another inquiry is from the Buenos Aires Electricity Works for 120,000 tons of sized coals for shipment over next year. These works already have a fairly substantial contract in course of being carried out and running well into next year, so that the fresh inquiry received from them is in the nature of a supplementary demand. The Swedish State Railways are also in the market for 196,000 tons of locomotive coals and about 8000 tons of bunker coals, but at the best only a very small part of this is likely to come to South Wales, owing to the much lower prices that can be quoted for North Country coals and also for Polish and German coals.

Labour Outlook.

The step taken by the Mining Association last week of inviting the Miners' Federation to appoint a subcommittee to meet their representatives to consider the question of wages and hours of work on a national basis was welcomed in this district, and hopes are entertained that something will emerge from the negotiations with the least possible delay in view of the harm that is likely to be done to trade if a settlement runs to the eleventh hour. As has been pointed out, unless measures are taken the hours of work at the pits revert to seven a day as from July 8th, and a reduction of working hours means an increase in the cost of production, which will be prejudicial to the competitive position of this country, and especially of South Wales. The feeling of traders generally here was voiced last week when the council of the Cardiff Chamber of Commerce passed a resolution expressing alarm at the grave dangers with which the coal industry is faced in consequence of the delay of the Government in dealing with hours of work in the coalfield. It also pointed out that any action which has the effect of increasing export costs will further reduce the volume of trade which has, during recent years, suffered considerably through foreign competition. The executive council of the South Wales Miners' Federation also met on Saturday last and passed a resolution urging the Government to introduce into Parliament without delay, a Bill to amend the Minimum Wages Act, 1912, along the lines submitted by the Miners' Federation of Great Britain. The resolution pointed out that past experience had abundantly proved that there is no hope of securing reasonable wages by negotiations with the coalowners, and that new legislation is the only means whereby another calamitous crisis in the coal industry in the near future might be averted.

The Navy and Coal.

The committee which was formed at the recent conference at Cardiff for the purpose of approaching the Admiralty on the question of reverting to the use of coal, met last week for the first time, and consideration was given to the draft petition to be presented to the Admiralty. A small sub-committee was formed to revise the draft carefully, and to obtain technical advice on the general question of coal being substituted for oil. As soon as the case is completed, the Admiralty, it was agreed, should be approached with a view to receiving a deputation consisting of the members of the committee.

Colliery Dispute.

The announcement was made last week that the negotiations for a settlement of the dispute which has meant that the Bedwas Colliery has been idle since November last, had broken down. About 2500 men are concerned. The management stated that the pits are open for work on the terms and conditions offered some time ago; but, according to the men's leaders, these terms demand that customs and conditions which had existed at the colliery for the last seventeen years would have to be done away with.

Tin-plate and Other Items.

It is reported that nine companies have decided to withdraw from the South Wales Tin-plate Corporation, but the Corporation will continue to exist. According to an official, the members which are withdrawing have decided to sell their shares and to make other arrangements about the selling of their tin-plates. It is further stated that the only reason for the action of the members concerned is the abnormally low demand for tin-plates, and not that the Corporation had been inefficiently run. Employees of the Yniscedwyn Tin Works, Ystradgynlais, are working under notice. Gurnos Tinworks were idle last week, and there was no work this week at Ystalyfera Tinworks. If certain conditions now under consideration by the men are accepted, there is every prospect that the Eagle Tin-plate Works, owned by Baldwins, Ltd., at Neath, which have been closed down for the last three months, will be re-opened about the middle of next month. The continued low price of spelter is responsible for the cessation of production on Friday of this week at the Llansamlet Works of the National Smelting Company. Notices to this effect were posted up during last week-end at the works, which are the most modern of their kind in the country. Operations have been carried out on a reduced scale for some time past, during which the men have shared the available work. The decision affects about 300 men.

Traffic Returns.

According to the Great Western Railway Company the total of imports and exports at the six docks in this district under their control for the four weeks ended May 10th last was 2,099,023 tons, which compared with 1,786,348 tons for the preceding month. For the whole of this year to May 10th the aggregate of imports and exports was 9,645,735 tons, which compares with 13,694,895 tons for the corresponding period of last year, a reduction of 4,049,160 tons.

Current Business.

Operations on the steam coal market have been in a state of suspense owing to the holidays. There was no work in the coalfield until Thursday of this week, which means the loss of about half a week's output. Standing stocks are, however, sufficient to meet all immediate requirements. Prices all round were nominal.

LAUNCHES AND TRIAL TRIPS.

Pilcomayo, twin-screw suction hopper dredger; built by Lobnitz and Co., Ltd., to the order of the Chilian Government; dimensions, 285ft. by 48ft. Engines, four 500 I.H.P.; trial trip, recently.

Kosmos II., twin screw steamer; built by Workman, Clark (1928), Ltd., to the order of the Hvalfangerselskapet Kosmos II. A/S., Sandefjord; dimensions, 600ft. by 77ft. by 53ft.; to carry whales. Engines, twin sets quadruple-expansion, pressure 250 lb. per square inch; constructed by the builders; launch, May 19th.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

E. G. Herbert, Ltd., has appointed Major S. H. Hall-Thompson, 10, Royal-avenue, Belfast, to represent it in Northern Ireland.

Burton, Griffiths and Co., Ltd., Birmingham, announce that Mr. Arthur Andrews has been appointed chairman of the company. The active control of the business is vested in Mr. F. W. Turrell. Mr. E. C. Farrell is taking up the position of sales director of the company.

Mr. John D. Troup, M.I. Mech. E., &c., having sold the whole of his shareholding in the *Engineering Review* Publishing Company, Ltd., has relinquished his directorship and also his position as managing editor of *Engineering and Boiler House Review*. His new business address is 34–35, High Holborn, W.C. 1, where he will publish his own journals. Telephone, Chancery 8686–7.

The Mond Nickel Company, Ltd., inform us that the board has appointed Mr. W. R. Barclay, who for some years has occupied the position of managing director of Henry Wiggin and Co., Ltd., to be consulting metallurgist to the Mond Nickel Company, Ltd., with headquarters in London. Mr. A. P. Hague, who is the general manager of the company's Clydach Refinery, will succeed Mr. Barclay as general manager, and at the same time will continue as general manager at Clydach. Mr. E. W. Asbury, who has for many years managed the sales department of Henry Wiggin and Co., Ltd., with headquarters at Birmingham, will, at the beginning of June, move to the offices of the Mond Nickel Company, Ltd., at Imperial Chemical House, Millbank, London, where he will continue in charge of the sales business of Henry Wiggin and Co.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	16/- to 20/6
(1) Spanish	16/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	15/3

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 12 0	—
No. 1 Foundry	3 16 0	—
No. 3 Foundry	3 13 6	—
N.E. Coast—		
Hematite Mixed Nos.	3 5 0	3 5 0
No. 1	3 5 6	3 5 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
Midlands—		
(c) Staffs.—	(Delivered to Station.)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 1 6 (a) / 4 3 6 (b) / 4 8 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 10 0	—
Common Bars	10 10 0	—
Best Bars	11 0 0	—
Double Best Bars	11 10 0	—
Treble Best Bars	12 0 0	—
Lancs.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	12 5 0	—
S. Yorks.—		
Crown Bars	10 0 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	9 10 0 to 10 7 6	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 12 6 to 9 0 0	—
Gas Tube Strip	10 17 6 to 11 0 0	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 10 0	10 0 0
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ½in.	7 10 0 to 7 15 0	8 0 0
Sheets (Gal. Cor. 24 B.G.)	11 7 6	11 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
Manchester—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 15 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	9 0 0	—
Sheffield—		
Siemens Acid Billets	9 10 0 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	7 2 6	—
Soft Basic	6 0 0 to 6 5 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 15 0	—
Midlands—		
Small Rolled Bars	6 15 0 to 7 5 0	—
Billets and Sheet Bars	5 2 6 to 5 15 0	—
Galv. Sheets, f.o.b. L'pool	10 5 0 to 10 10 0	—
(2) Staffordshire Hoops	9 10 0	—
(d) Angles	8 7 6	—
(d) Joists	8 15 0	—
(d) Tees	9 7 6	—
(d) Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 0 0	—

NON-FERROUS METALS.

Swansea—		
Tin-plates, I.C., 20 by 14	f.o.b.	14/3 to 14/6
Block Tin (cash)		102 1 3
„ (three months)		102 5 0
Copper (cash)		38 17 6
„ (three months)		39 0 0
Spanish Lead (cash)		11 10 0
„ „ (three months)		11 16 3
Spelter (cash)		10 10 0
„ (three months)		10 16 3
Manchester—		
Copper, Best Selected Ingots		41 0 0
„ Electrolytic		42 10 0
„ Strong Sheets		73 0 0
„ Tubes (Basis Price), lb.		0 0 10½
Brass Tubes (Basis Price), lb.		0 0 9½
„ Condenser, lb.		0 0 11½
Lead, English		12 17 6
„ Foreign		11 12 6
Spelter		11 0 0
Aluminium (per ton—raw ingot)		£85

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/11½ per lb.	
Ferro Tungsten	1/8½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£20 10 0	7/-
„ „ 6 p.c. to 8 p.c.	£19 10 0	7/-
„ „ 8 p.c. to 10 p.c.	£19 0 0	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£31 0 0	10/-
„ „ „ 1 p.c. carbon	£34 0 0	12/-
„ „ „ 0·70 p.c. carbon	£36 0 0	14/-
„ „ „ carbon free	10d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 0 0 scale 5/- per unit	
„ „ 75 p.c.	£18 0 0 scale 7/- per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£170	
Ferro Cobalt	9/- per lb.	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	14/-
„ „ Ell	14/9
„ „ Splint	14/6 to 16/6
„ „ Trebles	11/- to 11/6
„ „ Doubles	10/3 to 10/6
„ „ Singles	9/-
Ayrshire—	
(f.o.b. Ports)—Steam	13/-
„ „ Jewel	17/-
„ „ Trebles	11/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	10/3 to 12/
Screened Navigation	16/6 to 17/6
Trebles	11/6 to 12/6
Doubles	10/- to 10/6
Singles	9/-
Lothians—	
(f.o.b. Leith)—Best Steam	11/3 to 11/6
Secondary Steam	10/6
Trebles	12/-
Doubles	11/-
Singles	8/9

ENGLAND.

	Inland.	Export.
(8) N.W. Coast—		
Steams		20/-
Household		30/- to 51/-
Coke		20/- to 20/6
Northumberland—		
Best Steams		13/6
Second Steams		12/-
Steam Smalls		7/6 to 8/-
Unscreened		12/6 to 13/-
Household		27/- to 39/-
Durham—		
Best Gas		14/6
Second		13/3 to 13/6
Household		25/- to 37/-
Foundry Coke		24/-
Sheffield—		
Best Hand-picked Branch	25/6 to 27/-	—
Derbyshire Best Bright House	20/- to 22/-	—
Best House Coal	20/- to 21/-	—
Screened House Coal	18/- to 19/-	—
„ „ Nuts	15/- to 16/-	—
Yorkshire Hards	15/- to 16/6	—
Derbyshire Hards	15/- to 16/6	—
Rough Slacks	9/- to 10/-	—
Nutty Slacks	7/- to 8/-	—
Smalls	4/6 to 6/6	—
Blast-furnace Coke (Inland)	12/3 on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b.		14/- to 15/-

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	20/- to 20/3
Second Smokeless Large	18/9 to 19/9
Best Dry Large	18/6 to 19/6
Ordinary Dry Large	17/9 to 18/-
Best Black Vein Large	18/3 to 18/9
Western Valley Large	18/- to 18/6
Best Eastern Valley Large	17/9 to 18/-
Ordinary Eastern Valley Large	17/6 to 17/9
Best Steam Smalls	13/6 to 14/-
Ordinary Smalls	11/6 to 13/3
Washed Nuts	18/- to 21/-
No. 3 Rhondda Large	19/9 to 20/3
„ „ Smalls	15/6 to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/- to 36/6
Furnace Coke (Export)	16/6 to 17/6
Patent Fuel	20/6 to 21/-
Pitwood (ex ship)	23/- to 23/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	35/- to 37/6
Seconds	27/- to 31/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 45/-
Nuts	43/- to 46/-
Beans	24/9 to 28/3
Peas	20/- to 21/6
Breaker Duff	8/6 to 9/-
Rubbly Culm	8/6 to 9/6
Steam Coals:	
Large	20/6 to 21/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate: Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (e) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

Steel Export Trade.

THE continuous sagging of iron and steel prices on the international market indicates a state of things that leaves small hope for the future unless the Cartel succeeds in stemming the decline by limiting exports and suppressing the competition which is at present ruining the steel trade. On the Brussels Exchange quotations last week were down to £3 3s. for billets; £3 12s. for merchant bars; £3 7s. for joists of English sections; £3 11s. 6d. for angles and £3 17s. 6d. for rods. Prices have fallen about 40 per cent. in two years. A meeting in Paris last week of the Steel Cartel Committee appears to have made further progress with the preliminary negotiations by proposing to fix quotas for export on the basis of the average figures for the past five years. Other meetings are to be held, and there is hope that a satisfactory agreement will be reached in time to allow the Cartel to be reconstituted at the end of June.

Railway Reforms.

The Superior Railway Council has presented its recommendations of reforms to be carried out by the railway companies. Those dealing with technical matters are to be examined and reported upon by separate commissions, so that a complete scheme to save the companies from financial disaster may be ready by November next. The unsatisfactory working of the local railways is to be remedied by making them more adaptable to the limited, and often irregular, traffic by employing both rail and road motor vehicles. This step, it is believed, will enable the services to be worked in the most economical way to suit the traffic. For the main lines electrification is regarded as the best solution, because with it charges do not increase proportionately to the growth of traffic, and a heavier traffic means greater economies. It is suggested that the Superior Council of Public Works should deal with this matter and prepare a report which will be incorporated in the general scheme. One of the chief sources of deficit is the suburban traffic, which, it is maintained, should be separated entirely from the main lines and worked together under a common management, which would allow of an acceleration of traffic and greater convenience to users. It is affirmed that enormous economies could be effected in this way. A commission should be formed composed of the Metropolitan Railway Company, the omnibus and tramway services and representatives of the Paris Municipality, and of all the Departments interested in order to determine the conditions under which this separate organisation for the suburban service should be created. Economies are suggested in the railway working expenses, which should amount to 400 million francs during the present year. There is also proposed a reduction in the new works which the companies are authorised to carry out, but those works already begun are to be completed, and a cut of 547 million francs in the purchase of rolling stock is suggested. It is recommended that all schemes for the construction of new lines should be suspended. The facilities which the railway companies are under the necessity of providing for free travel must be strictly limited, and the contracts with the State must be revised, so that the State will not impose upon the railway companies more than reasonable burdens for the transport of mails and for other purposes. As regards railway rates, those for goods will remain unchanged, because it is feared that any advance would have serious consequences at a time of trade and commercial depression, but the rates for passengers will be established on the pre-war basis, which means that there will be an increase of something like 25 per cent. At the same time, the State is requested to reduce the exorbitant fiscal tax of 32 per cent. on passenger tickets to an amount which, with the increase in passenger rates, will produce for the Treasury about a quarter of what it now receives. The recommendations have not been well received by railway users and by makers of rolling stock and other material, and as the Government intends to institute a Parliamentary inquiry, it is by no means certain that all the recommendations will be adopted.

Strikes.

The strike of textile operatives in the Roubaix district is characteristic of the state of affairs in other branches of industry, and is an indication of what may happen on a larger scale unless something is done to arrest the downward movement of trade. It is argued that the general condition of things would not be so bad if the State laid a less heavy hand on all industrial enterprise. Manufacturers find that they must lower production costs and that wages must be reduced, but the men refuse to accept any reduction so long as there is no lowering of the cost of living. When the social insurance scheme came into operation the men would not accept any retention of premiums out of wages, and in order to avoid a conflict the employers took the payment of the whole of the insurance premiums on themselves by returning to the men their share in the form of a bonus. Subsequently, when the situation called for strict economy, the employers posted notices for a reduction of 10 per cent. in wages, which the men resisted, and in the hope of preventing a strike the employers withdrew the notice and announced that the men would be required to pay their premiums for insurance, which they are legally bound to do. This step aggravated matters, because the men have all along refused to accept the principle of compulsory insurance. Employers say that they cannot give way unless they are relieved of some of the heavy social and other charges that burden industry.

Foreign Trade.

The continuous decline of foreign trade is again revealed in the returns for the first four months of the year, which show a heavy contraction all round, except in the imports of produce. In all cases values have fallen more rapidly than quantities. The total value of imports was 15,712 million francs, a decline of 2868 million francs as compared with the first four months of 1930. Exports were valued at 11,283 million francs, a decline of 4291 million francs.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

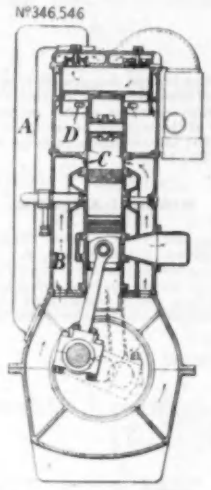
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

346,546. March 17th, 1930.—OPPOSED PISTON ENGINES, C. H. Fowler and H. Cooper, Steam Plough and Locomotive Works, Leeds.

This engine is of the opposed-piston type, with a scavenging pump arranged above the main cylinder and driven by the upper piston. The pump delivers air by the trunk A to the crank case

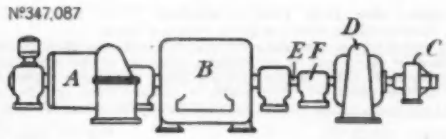


of the engine, and thence by the passage B to the scavenging ports C. The liner of the scavenging pump is provided with ports D, which are uncovered by the piston at each stroke, and then communicate with the atmosphere. The position of these ports can be altered comparatively cheaply, to meet the requirements of the working conditions of the engine, without interfering with the remainder of the machine.—*April 16th*, 1931.

DYNAMOS AND MOTORS.

347,087. September 29th, 1930.—DYNAMO-ELECTRIC MACHINERY, The English Electric Company, Ltd., of Queen's House, 28, Kingsway, London, W.C. 2; John Picton Chittenden, of South Lodge, Westfield, Rugby; and John Arthur Osborn, of 50, Styvechale-avenue, Earlsdon, Coventry.

Owing to the increasing size and efficiency of high-speed turbine-driven electric generators, it has become increasingly difficult to design a cooling fan to deliver the necessary quantity of low-pressure air for the generator and to run at the same speed

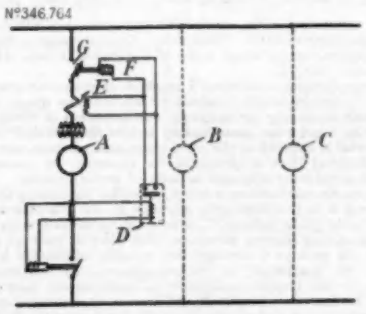


as the generator. A separate motor-driven fan has therefore been resorted to. To obtain a more efficient exciter, the latter has also been driven through gearing at a lower speed than the generator. In accordance with the invention, the gearing used for driving the exciter is also used to drive the fan. The accompanying drawing illustrates this arrangement. A turbine A drives a direct-coupled high-speed electric generator B, whilst the exciter C and blower D for cooling the generator are both driven at a reduced speed from the shaft E of the latter, through a gear-box F.—*April 28th*, 1931.

SWITCHGEAR.

346,764. October 10th, 1929.—PROTECTION OF ELECTRIC MERCURY ARC RECTIFIERS, Aktiengesellschaft Brown, Boveri et Cie., of Baden, Switzerland.

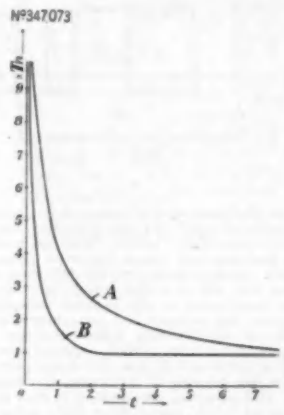
For the selective protection of mercury arc rectifiers operating



in parallel on a continuous-current network arrangements are known in which the disconnection of the rectifier on the A.C. side is effected by means of an oil switch, having a maximum current release operating with a time lag and current transformer feed, and on the continuous-current side by a reverse current relay. Normally the secondary winding of the current transformer is short circuited by contacts on the reverse current relay. Hence the effectiveness of the arrangement is dependent on the reverse current on the continuous-current side of the rectifier. The case may, however, occur that of a number of rectifiers A B C working in parallel only a single rectifier is operative for a certain period. When employing the known arrangement, the rectifier is not disconnected instantaneously, on a reverse current occurring in the rectifier itself, owing to lack of a reverse current on the A.C. side, but by the excess current protective arrangement which operates with a time lag. Should the reverse current continue for any length of time the electrodes may be damaged. According to the invention, this disadvantage is overcome by the provision on the continuous-current side of the rectifier in addition to the reverse current relay which operates the D.C. switch, of a relay D which responds only to an outgoing current, the working contacts of which lie in the secondary circuit of the current transformer E on the A.C. side, and which relay short circuits the secondary winding of the current transformer. Should an arc between anodes occur in a single-feed rectifier, a short-circuit current will be set up on the A.C. side and the current on the continuous-current side will fall to zero. The current transformer and consequently the releasing coil F for the oil switch G are not short circuited, and the oil switch is instantaneously released, so that damage to the electrodes and the rectifier is avoided.—*April 10th*, 1931.

347,073. July 25th, 1930.—BI-METAL ELECTRIC CUT-OUTS, Felten und Guilleaume Carlswerk Actien-Gesellschaft, of Köln-Mulheim, Germany.

The usual types of overload cut-outs with bi-metal strips present the disadvantage that their time lags vary but little with the value of the overload currents. In the diagram the overload current is indicated as a function of the time lag of the cut-out for an ideal and for a practical overload cut-out, the time being indicated on the abscissa and the overload current being indicated on the ordinate as a multiple of the normal current. The form of the curve of the current as a function of the time lag of the ideal cut-out corresponds somewhat to the

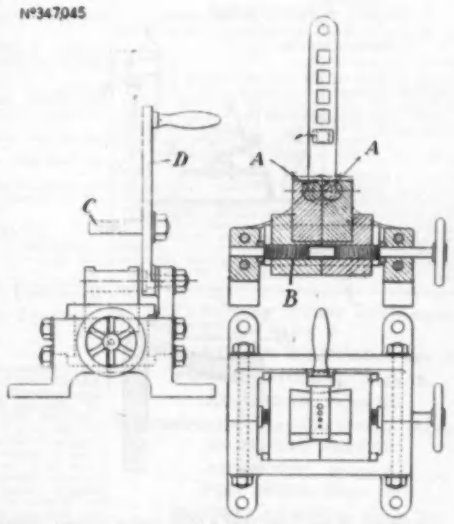


curve A, whilst the curve showing the current as a function of the time lag of bi-metal cut-outs as hitherto employed has the form corresponding somewhat to the curve B. It will be seen that for mean overload currents it is preferable to increase the time lag of the overload cut-out. According to the invention, a resistance is inserted in shunt with the bi-metal, and as far as possible the resistance is independent of the temperature. As the resistance of the bi-metal increases with increasing temperature, the shunt resistance, which is independent of the temperature, reduces the strength of the current in the bi-metal for mean overload currents, whereby the time lag is increased.—*April 23rd*, 1931.

MEASURING AND TESTING INSTRUMENTS.

347,045. June 5th, 1930.—A WIRE TESTING MACHINE, R. Johnson and Nephew, Ltd., and R. A. C. Johnson, Bradford Ironworks, Manchester.

The object of this invention is to provide a device for testing wire by bending, in which the testing conditions will remain similar regardless of the wire being tested. The bend is effected



round the exposed surface of the two cylindrical dies A A, between which the wire is clamped by the screw B. The dies and their supporting blocks can be changed to provide different radii of curvature. The free end of the wire is threaded through one of the holes in the peg C of the bending lever D. This lever is pivoted exactly opposite the meeting plane of the two dies.—*April 23rd*, 1931.

347,339. February 7th, 1930.—MEASURING APPARATUS FOR ELECTRIC HIGH POTENTIAL CIRCUITS, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2, and Charles Gilbert Mayo, of 17, Alexandra-road, Rugby.

A known arrangement for obtaining a voltage proportional to the high potential existing on a conductor is shown in Fig. 1. The conductor is illustrated at A, whilst B and C show diagrammatically portions of a capacitance bushing by which the conductor A is insulated from earth potential at D. In this arrangement a potential transformer having a primary winding E is connected between earth at D and a tapping on the capacitance bushing illustrated as the connection between the condensers B and C through a series reactance F. The voltage proportional to that of the conductor A is produced across a portion of the secondary winding G of the potential transformer and is utilised, for example, at H, which may be a measuring instrument relay, or the like. A condenser J is preferably provided for neutralising the inductive part of the measuring instrument or relay H, and also the magnetising current of the potential transformer. The proportionality between the secondary voltage obtained at H and the primary voltage on the conductor A is, however, only maintained if

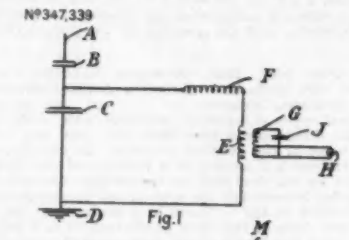


Fig. 1

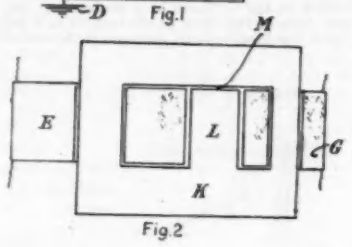


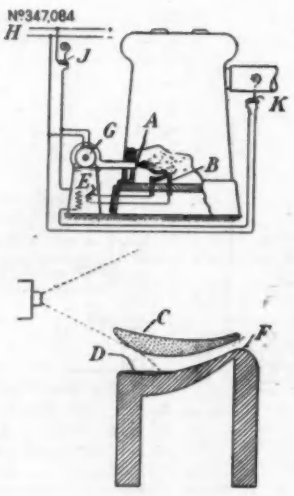
Fig. 2

the burden on the secondary winding of the potential transformer is relatively small and the potential drop across the reactor F is correspondingly small. With an increase in these two factors, however, the strict degree of proportionality is not maintained. In accordance with the invention, the reactance F is combined with the potential transformer by constructing the potential transformer in the manner indicated in Fig. 2. For this purpose, the primary and secondary windings E and G respectively of the potential transformer are arranged on the two outer limbs of a laminated magnetic core K, which is provided with a third limb L, this limb being provided with an air gap M for the purpose of increasing the reactance of the transformer. The potential transformer is thus approximately equivalent to an ideal transformer with series inductance. The value of the series inductance may be measured by short-circuiting the secondary winding G of the potential transformer and measuring the impedance of the primary winding E, while the effective ratio may be obtained by measuring the voltage on the winding G with a high resistance voltmeter so as to minimise the effect on the reactance. By employing such an arrangement the inventors not only obtain the advantage of the use of a single unit combining the potential transformer with the reactance F, but one core and winding, with the consequent losses therein are eliminated.—*April* 30*th*, 1931.

FURNACES.

347,084. September 16th, 1930.—OIL BURNERS, *The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C. 2.*

This device is obviously intended for use in connection with house-heating, oil-fired furnaces, which are controlled by thermostats. The object appears to be to keep the burner in full blast, or to extinguish it entirely according to the room temperature. Beneath the burner jet A there is a "resistor" B, which is shielded from the direct radiation of the flame by the refractory

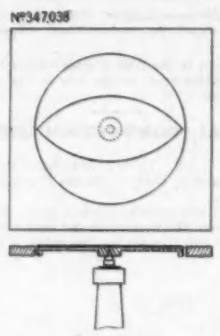


C. The resistor is so formed that a little pool of oil may collect at D. This oil is vaporised by the heat of the resistor, supplied by electric energy from the transformer E. The gases thus formed pass over the hot spot F, are ignited and produce a flame for the ignition of the main jet of atomised oil. This jet is supplied by the motor G, which draws current from the mains H, and is controlled by the room thermostat J. There is another thermostat K in the flue for the control of the ignition resistor, but this is, of course, ineffective until the room thermostat starts the spraying motor G.—*April* 23*rd*, 1931.

CRUSHING AND GRINDING.

347,038. May 26th, 1930.—GRINDING WHEELS, K. Drapák, Reichenberg 369, Rochlice, near Liberec, Czechoslovakia.

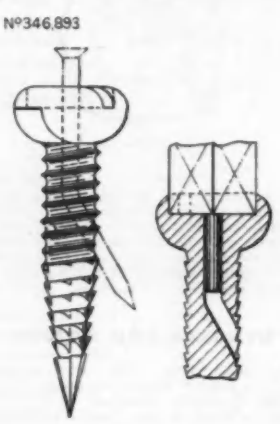
It is obvious that in using a surface disc grinder or polisher that part of the disc near the periphery must cut faster than that near the centre and as a consequence uneven work may be produced. The inventor equips the disc with an abrading surface of lozenge shape, so that the arc of contact with the workpiece will be approximately constant at any radius. No mention is made of the effect of the relative linear speed at different radii, but it is claimed that the arrangement helps in the discharge of detritus.—*April* 23*rd*, 1931.



MISCELLANEOUS.

346,893. February 5th, 1930.—WOOD SCREWS, J. Lidbetter, 60, Hanover-terrace, Brighton, Sussex.

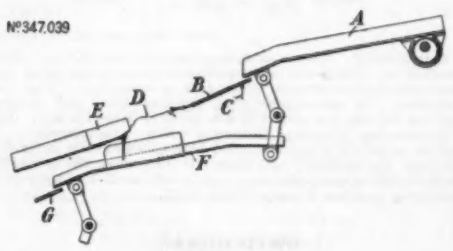
The inventor proposes to provide a screw with an axial hole, so that a tang on the driver can be inserted and the driver thus prevented from sliding out of engagement with the slot in the screw head. Incidentally, the tang holds the screw on the end of



the driver, so that it may be readily driven into the workpiece. The axial hole is deflected, half-way down the length of the screw, to one side. When the screw is screwed home a nail is driven down the hole, and, protruding at the side, prevents the screw from slacking back. The process of manufacture is not mentioned.—*April* 23*rd*, 1931.

347,039. May 27th, 1930.—SCREENING COAL, W. Barker, Shooters Hill, near Longton, Stoke-on-Trent.

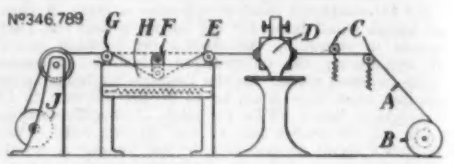
It would appear that the screening or classifying effect of this machine is dependent on the relative elasticity of coal and shale or other dirt. The dirty coal is fed down the jigging chute A on to the plate B. This plate is pivoted and is given a



vibratory movement, indicated at C, with a period of 2000 to 3000 strokes per minute. It is suggested that the coal passing off the lower lip of the plate B will leap the gap D and reach the chute E, while the dirt will fall on to the lower chute F. If this dirt carries with it any coal, the mixture may be further classified on another vibrating plate G.—*April* 23*rd*, 1931.

346,789. January 17th, 1930.—MANUFACTURING VULCANISED RUBBER-INSULATED ELECTRIC CONDUCTORS, *Standard Telephones and Cables, Ltd., of Columbia House, Aldwych, London, W.C. 2.*

This specification describes a method of manufacturing vulcanised rubber-insulated conductors wherein the whole or part of the heat necessary for inducing vulcanisation is obtained by heating the conductor immediately before the uncured insulating material is applied to the conductor, and wherein any necessary additional heat is obtained, for example, by passing the insulated conductor through a bath of molten metal. A is a metallic conductor held on a supply reel B. In passing from the supply reel B to the insulating machine D, the conductor makes contact with guide pulleys C, which are connected with a controlled source of electric power, so that electric current passing between the pulleys C through the metallic conductor A causes heat to be generated in the conductor. In the insulating machine D the heated conductor is continuously coated with uncured rubber compound. It will be seen that immediately the rubber compound comes into intimate contact with the heated metallic conductor, the radiation of heat from the conductor will induce vulcanisation of the compound. According to the heat of the conductor, the nature of the rubber compound and the speed of the conductor, vulcanisation will be either complete or partial. In cases where vulcanisation is complete, the insulated conductor is led over pulleys E and G, as shown by the dotted line, to a capstan unit, which imparts controlled longitudinal movement to the conductor and winds up and traverses the completed work on the take-up reel J. In cases where vulcanisation is incomplete, the insulated conductor is led by means of



guide pulleys E, F and G, through a bath of molten metal alloy H, which supplies the additional heat necessary for complete vulcanisation. After leaving the guide pulley G the completed work is passed to and received by take-up reel J, as previously described. The metallic alloy bath H may be made of any of the well-known fusible alloys or of combinations thereof to obtain the desired melting and flow points.—*April* 17*th*, 1931.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY AND SATURDAY, MAY 30TH.

VEREIN DEUTSCHER CHEMIKER.—Vienna. Fifth general meeting for chemical apparatus. Symposium, "The Separation of Liquids and Solids."

SATURDAY TO SUNDAY, MAY 30TH TO JUNE 14TH.

INSTITUTE OF TRANSPORT.—Italian Tour and Congress. For provisional programme see page 359.

MONDAY, JUNE 1ST.

CHARTERED SURVEYORS' INSTITUTION.—12, Great George-street, Westminster, S.W. 1. Annual general meeting. 5 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W. 1. General meeting. 5 p.m.

MONDAY TO FRIDAY, JUNE 1ST TO 5TH.

INTERNATIONAL FEDERATION FOR HOUSING AND TOWN PLANNING.—Berlin. Thirteenth International Housing and Town Planning Congress.

TUESDAY TO FRIDAY, JUNE 2ND TO 5TH.

INSTITUTION OF GAS ENGINEERS.—At the Institution of Civil Engineers, Great George-street, Westminster, S.W. 1. First International Gas Congress and sixty-eighth annual general meeting. For programme see page 585.

WEDNESDAY, JUNE 3RD.

INSTITUTION OF STRUCTURAL ENGINEERS.—10, Upper Belgrave-street, S.W. 1. Lecture and demonstration, "The Art of Making and Using Concrete." Lecture I., "Types of Cements and their Peculiarities." 6 to 8 p.m.

THURSDAY, JUNE 4TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "A New Prime Mover," by Mr. J. F. J. Malone. 6 p.m.

FRIDAY, JUNE 5TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W. 1. Discourse, "Habit: The Driving Force in Evolution," by Dr. E. W. MacBride. 9 p.m.

WEDNESDAY, JUNE 10TH.

INSTITUTION OF STRUCTURAL ENGINEERS.—10, Upper Belgrave-street, London, S.W. 1. Lecture and demonstration, "The Art of Making and Using Concrete—Lecture II.: The Raw Materials of Concrete and their Field Testing," by Mr. H. A. Holt. 8 p.m.

WEDNESDAY, JUNE 17TH.

INSTITUTION OF LOCOMOTIVE ENGINEERS (LONDON): BIRMINGHAM CENTRE.—Visit to the Austin Motor Company, Ltd., Coventry Works. 2 p.m.

WEDNESDAY TO SATURDAY, JUNE 17TH TO 20TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Birmingham. Fifty-eighth annual general meeting and conference. For programme see page 524.

WEDNESDAY, JUNE 24TH.

STAFFORDSHIRE IRON AND STEEL INSTITUTE.—Annual excursion. Visit to the National Physical Laboratory, Teddington.

MONDAY TO SATURDAY, JUNE 29TH TO JULY 4TH.

INSTITUTION OF NAVAL ARCHITECTS.—Paris summer meeting. For programme see page 514.

THURSDAY, JULY 9TH.

BRITISH ELECTRO-FARMING CONFERENCE.—In the Members' Large Tent, Royal Agricultural Show, Warwick. Sixth Conference. "Electricity on the Farm, including Dairy and Poultry Farming," by Mr. M. M. Harvey. 3 p.m.

MONDAY TO SATURDAY, JULY 13TH TO 18TH.

SOCIETY OF CHEMICAL INDUSTRY.—Jubilee Celebrations. For provisional programme see page 471.

A NEW OIL FILLER.—We have received from Joseph Kaye and Sons, Ltd., of Leeds, a new 2-pint seamless steel oil filler. This type of filler has recently been improved. The spout has been widened to ¼in. diameter at the orifice and, being double wrapped by a special process, is equivalent to a seamless tube, while at the same time the method of construction ensures strength. Even the slide which covers the filling aperture is an "engineer's job." The handle is made of steel riveted strongly on to the body. The whole filler is stoutly constructed for hard usage.